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BY

LIBBIE H. HYMAN

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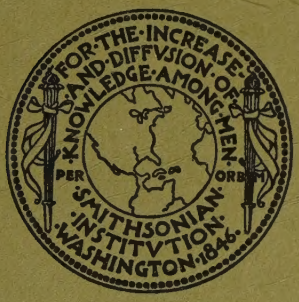

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A FURTHER STUDY OF MICRONESIAN POLYCLAD FLATWORMS

By Libbie H. Hyman [1]

The material treated in this article was assembled from several sources: one vial from the Templeton Crocker Expedition of 1933, collected at Vanikoro Island; one vial taken at Guam by D. H. Johnson; three vials collected by Cadet Hand at Kapingamarangi Atoll in the Caroline Islands; six vials from Eniwetok Atoll collected by D. J. Reish; 21 vials collected on Ifaluk Atoll, western Carolines, under the auspices of the Pacific Science Board Atoll Research Program, 1953, mainly by D. P. Abbott, some by F. M. Bayer and others; 20 vials collected in the Palau Islands, 1955, by a team composed of R. R. Harry, H. A. Fehlmann, and F. M. Bayer, from Stanford University and the U. S. National Museum (USNM); and two polyclads found in a miscellaneous collection of material from the Palau Islands presented to the American Museum of Natural History (AMNH).

The field work at Ifaluk and Kapingamarangi Atolls was supported by funds from Contract N 7–onr–29104 (NR 388–001) by the Office of Naval Research, Department of the Navy, and National Academy of Sciences. Work at Palau was undertaken by arrangements with the Pacific Science Board (National Academy of Sciences—National Research Council) and the Office of Naval Research under Contract N 7–onr–291 (57).

The polyclads of the tropical and subtropical waters of the vast Indo-West Pacific region are imperfectly known and have not been

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systematically collected. Species from this area are widely scattered in the literature. Articles dealing specifically with Micronesian polyclads are those of Kato (1943) and Hyman (1955b). Kato listed three new and four known species from the Palau Islands, of which only one was recovered in the present material, and Hyman two new and two known species from Micronesia, of which one has been recovered here. The prevalence of known species in even such small collections indicates a wide distribution of polyclad species in the Indo-West Pacific area.

Taxonomic categories have been defined in previous publications, especially Hyman (1953a), and definitions will not be repeated here. Only categories not found in previous articles will be explained.

Order Polycladida

Suborder Acotylea

Section Craspedommata

Family Latocestidae Laidlaw, 1903

Latocestus pacificus Laidlaw, 1903

Figure 1*a–c*

Material: One specimen collected by the Stanford team at the Palau Islands, Sta. 64, from a small bay at the south end of the lagoon of Eil Malk, Aug. 7, 1955.

General characters: The worm, 11 mm. long and about 1 mm. wide, has the strap shape typical of the genus (fig. 1*a*). It is brown, of thick, opaque consistency. The numerous small eyes begin well posterior to the anterior margin as a median band, irregular at first but becoming bilateral in arrangement before reaching the brain; anterior to the brain the eyes spray out over the anterior end as usual in the genus (fig. 1*b*). The marginal eyes are not well delimited from the frontal eyes but continue for a short distance posterior to the level of the brain. The position of the brain is shown in figure 1*b*. Because of the dark, opaque consistency of the worm the exact arrangement of the eyes was difficult to ascertain and, further, little could be seen of the internal anatomy. The short ruffled pharynx with the mouth at its posterior end occurs near the posterior end of the worm as typical of the genus, and between the mouth and the posterior margin are seen the male and female gonopores (fig. 1*a*).

Copulatory apparatus: The posterior end of the worm was removed and sectioned sagittally. The contained copulatory apparatuses are shown in sagittal view in figure 1*c* and are characteristic of the genus. The free prostatic vesicle with thick muscular wall and

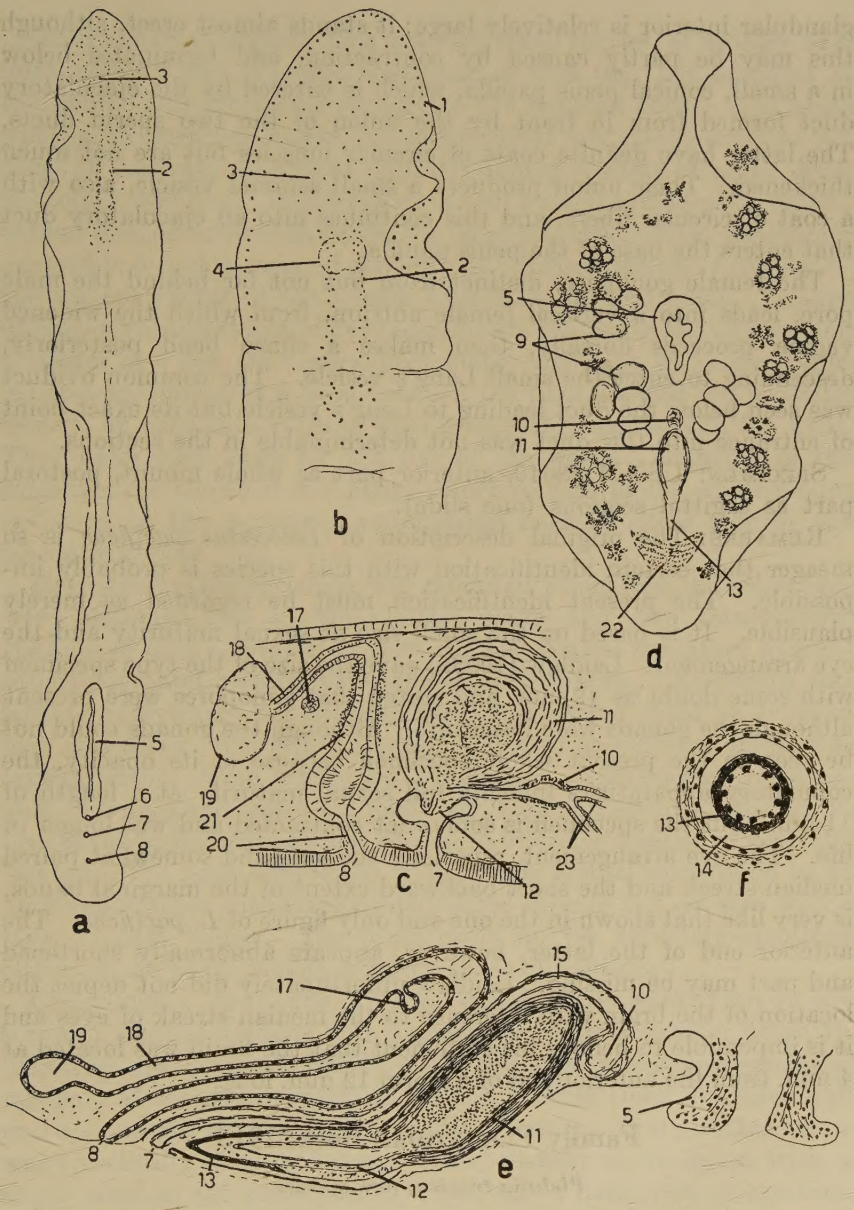

FIGURE 1.—*a–c*, *Latocestus pacificus: a*, dorsal view; *b*, anterior end, enlarged, showing eye pattern; *c*, sagittal view of copulatory apparatuses. *d–f*, *Plehnia tropica: d*, dorsal view; *e*, sagittal view of copulatory apparatuses; *f*, cross section through penis stylet. (For explanation of numbered parts see p. 597.)

glandular interior is relatively large; it stands almost erect, although this may be partly caused by contraction, and terminates below in a small, conical penis papilla, which is entered by the ejaculatory duct formed from in front by the union of the two sperm ducts. The latter have definite coats of circular muscles but are not much thickened. Their union produces a small seminal vesicle, also with a coat of circular fibers, and this continues into an ejaculatory duct that enters the base of the penis papilla.

The female gonopore, distinct from but not far behind the male pore, leads into a vertical female antrum, from which the widened vagina proceeds dorsally, then makes a sharp bend posteriorly, descending to enter the small Lang's vesicle. The common oviduct was seen below the duct leading to Lang's vesicle but its exact point of entrance into this duct was not determinable in the sections.

SPECIMEN: USNM 28640, anterior part as whole mount, postoral part as sagittal sections (one slide).

REMARKS: The original description of *Latocestus pacificus* is so meager that certain identification with this species is probably impossible. The present identification must be regarded as merely plausible. It is based on the small size at sexual maturity and the eye arrangement. Laidlaw (1903a) gave the size of the type specimen with some doubt as 12 mm. and stated that gonopores were present although the gonads were immature. Although the gonads could not be seen in the present whole specimen because of its opacity, the copulatory apparatuses indicate full sexual maturity at a length of 11 mm., but the specimen is somewhat contracted and was longer in life. The eye arrangement, especially the long and somewhat paired median streak and the short backward extent of the marginal bands, is very like that shown in the one and only figure of *L. pacificus*. The anterior end of the latter, however, appears abnormally shortened and part may be missing. Laidlaw unfortunately did not depict the location of the brain with reference to the median streak of eyes and it is impossible to believe his statement that the brain was located at 4 mm. from the anterior end of a worm 12 mm. long.

Family PLEHNIIDAE Bock, 1913

Plehnia tropica, new species

FIGURE 1*d–f*

MATERIAL: Several specimens, of which five were usable, taken from the alcyonacean *Nephthea* by the Stanford team at the Palau Islands, Sta. 254, reef south of Ngaremediu, east end of Urukthapel, Oct. 27, 1955.

GENERAL CHARACTERS: This is a very small species, of broadly oval form, about 2 mm. long and about half as wide (fig. 1*d*), broadest at the middle and decreasing slightly to the rounded ends. It is white with sprawling black marks in a longitudinal row along each side but some of these are associated with developing clusters of eggs. Eyes are totally wanting. In the center is seen a small ruffled pharynx and behind this, directed backwards, the large prostatic vesicle, posteriorly encased in a conical pointed penis stylet. Behind the tip of the stylet, the cement glands of the female apparatus are noticeable. Groups of eggs in various stages of development are evident in the interior and a cluster of a few very large, presumably ripe eggs was conspicuous in most specimens at a level between the pharynx and the prostatic vesicle, on each side. These were presumably enclosed in the uteri. They seem very large for the size of the worm. Branches of the intestine, not shown in the figure, could be seen in the whole mount radiating to the periphery and passing back to either side of the prostatic vesicle.

HISTOLOGY: One specimen was mounted whole and the other four were sectioned, two in the sagittal plane and two transversely. Because of lack of proper fixation the histological condition was unsatisfactory and yielded little definite information. Epidermis was lacking everywhere but subepidermal musculature could be detected here and there. The whole interior appeared as a fibrous mesh containing nuclei. Even branches of the intestine were scarcely recognizable. Ovaries and testes are relatively large and about fill the thickness of the body, hence cannot be said to be either dorsally or ventrally located. The large eggs noted in the whole animal were found to be very yolky, filled with large eosinophilous spheres and covered with a layer of dark bodies. The brain could not be definitely identified either on the whole mount or in the series of sections.

COPULATORY APPARATUS: This was satisfactorily worked out on one series of sagittal sections and is shown in sagittal view in figure 1*e*. The large oval prostatic vesicle, of the free type, is the most conspicuous part of the male apparatus. It has a fairly thick muscular wall and a glandular interior of eosinophilous nature. It is oriented somewhat vertically with a forward slant; distally it continues with a sharp bend as the penis papilla which has a horizontal orientation. The elongate penis papilla is housed in a male antrum of the same shape. At its distal end the penis papilla is encased in a sclerotized cone taking the eosin stain that may be regarded as a penis stylet. A cross section through this part of the penis papilla is shown in figure 1*f*. The stylet is covered with a thin layer containing flattened nuclei and is lined by a cuboidal epithelium continuous with the lining epithelium of the unsclerotized part of the penis papilla. Anterior to

the proximal end of the prostatic vesicle is found the small, muscular seminal vesicle from which the ejaculatory duct proceeds, passing above the prostatic vesicle and continuing along the posterior side of the latter and dorsal to the penis papilla to open just behind the male gonopore or perhaps, one should say, in common with it. This is certainly a very strange course for an ejaculatory duct; one expects it to enter the base of the penis papilla and this is the case in other species of *Plehnia*. However, the course described appeared clearly indicated in the sagittal series mentioned; it could not be clearly made out in the other series but neither could any entrance into the penis papilla be found. The ejaculatory duct is composed chiefly of a thin muscular wall of longitudinal fibers.

The female apparatus is very similar to that of *Plehnia arctica* (Plehn, 1896). The female gonopore is found shortly behind the exit of the ejaculatory duct. It leads into a long vagina much slanted forward and paralleling the ejaculatory duct. About at the level of the proximal end of the prostatic vesicle the vagina makes a backward curve and after receiving the common oviduct proceeds posteriorly parallel to the vagina as a long duct that terminates in a small oval Lang's vesicle. The whole tract consists of a cuboidal epithelium in which cell walls were missing and has but a slight muscular investment. The large cloud of eosinophilous cement glands, conspicuous in the whole mount, were in evidence in the sections along the vagina but have been omitted from the figure.

DIFFERENTIAL DIAGNOSIS: *Plehnia tropica* differs from other eyeless species of the genus in the course of the ejaculatory duct and the sclerotization of the distal end of the penis papilla.

HOLOTYPE: USNM 28641, one whole mount; also USNM 28685, best set of sagittal sections (one slide).

REMARKS: This is the third eyeless species of *Plehnia* to be discovered. The type of the genus, *Plehnia arctica* (Plehn, 1896), the first example of an eyeless polyclad, came from Spitzbergen. The second, *Plehnia caeca* Hyman (1953a) came from the California coast at some depth and was also found to occur in a variant with two cerebral groups of small eyes. Whether the association of the present species with an alcyonacean is obligatory or accidental cannot be stated but the large yolky eggs and the relatively large copulatory apparatus indicate some tendency to parasitism. The total want of eyes in an acotylean polyclad poses a systematic dilemma as the present classification of the Acotylea is based upon eye arrangement. However, Bock (1913) satisfactorily placed *Plehnia* among the Craspedommata and established the family Plehniidae.

Section Schematommata

Family Leptoplanidae Stimpson, 1857

Stylochoplana minuta, new species

Figure 2*a–c*

Material: One specimen collected from algal washings in the intertidal zone, Sept. 22, 1953, on Ifaluk Atoll between Elangalap and Falarik Islets, Sta. 65–D–3. Another specimen, collected by D. Reish, Sept. 4, 1956, on fronds of algae on the reef flat on Eniwetok Atoll, Sta. E–79, was doubtfully assigned to this species.

General features: This is a very small species; the Ifaluk specimen was 5 mm. long, the Eniwetok specimen 4 mm. long. But both specimens were seen to be sexually mature by the presence of relatively large eggs in a lateral strand on each side (fig. 2*a*). The form is typically leptoplanid, slender, elongated, rounded anteriorly, tapering to a pointed posterior end. Tentacles are wanting. Both specimens appeared colorless or white. The eyes of both specimens are not arranged in tentacular and cerebral clusters, as common in the Leptoplanidae, but form a single irregular row, of 15 eyes on one side, 12 on the other, in the Ifaluk specimen (fig. 2*b*). They were not counted in the other specimen. Even in the cleared specimens little could be seen of the interior structure except the presence of eggs.

Copulatory apparatus: The posterior end of the Ifaluk specimen was removed and sectioned sagittally. The copulatory apparatuses found therein are depicted in figure 2c. The gonopores are somewhat distant from each other (about 0.5 mm.). The male gonopore leads into a tubular, slanting male antrum that appeared to widen internally around a probable penis papilla but these parts were imperfectly present in the sections, hence their representation in figure 2*c* is somewhat conjectural. The lining epithelium of the male antrum is highly glandular, filled with coarse eosinophilous granules. The presence of a penis papilla could not be definitely ascertained. There is present an elongated oval prostatic vesicle with muscular wall and glandular interior. Beneath its proximal end occurs an oval muscular seminal vesicle; the connection of this with the prostatic vesicle was vague in the sections but probably occurs as indicated by the dotted lines in figure 2*c*. The expanded spermiducal vesicle filled with sperm was seen entering the seminal vesicle.

The female apparatus was in a better state of preservation than the male apparatus and its details could be ascertained. The female antrum ascending in a curve from the gonopore is continuous with the vagina of which the distal part is remarkable for its thick mus-

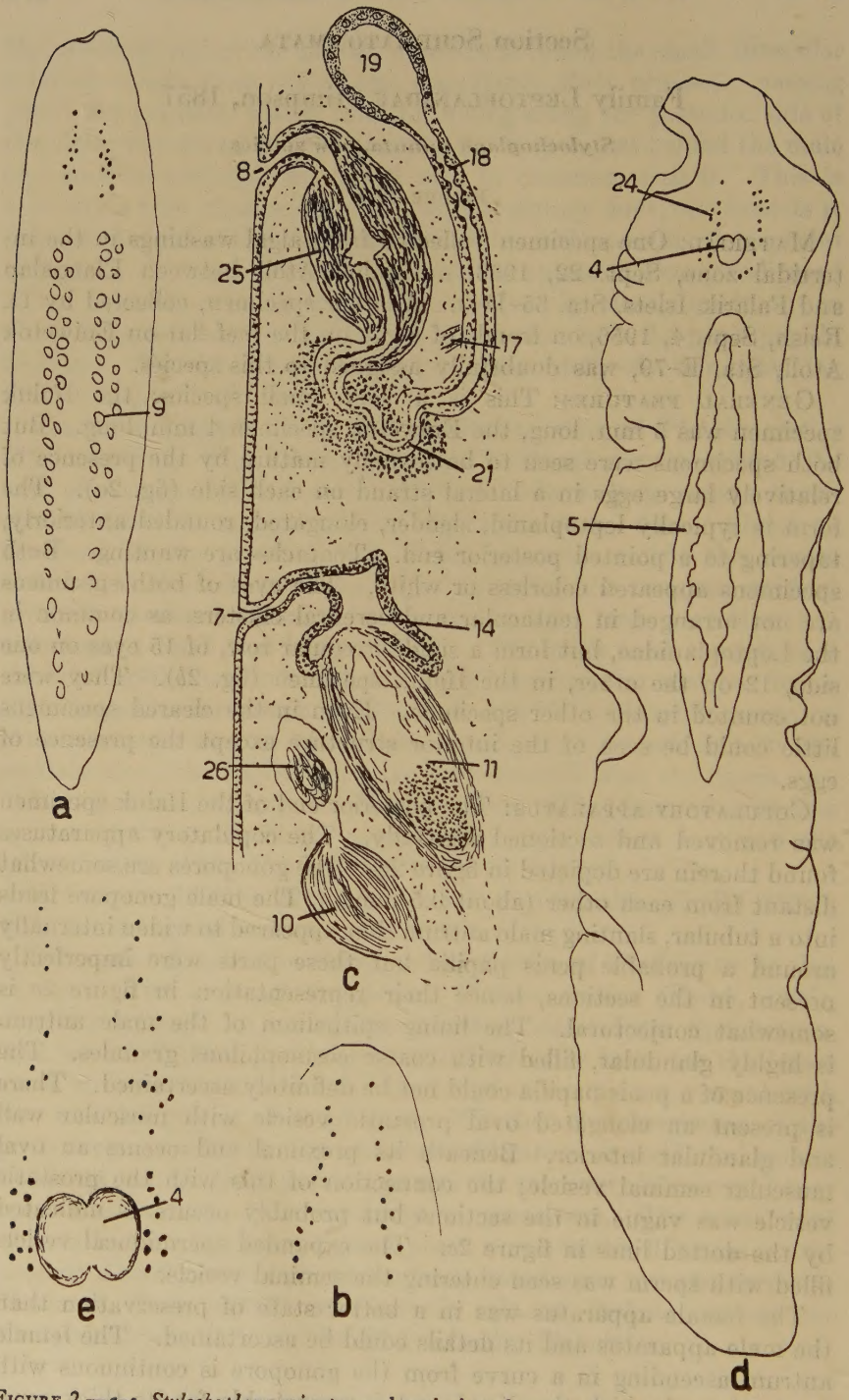

FIGURE 2.—*a–c*, *Stylochoplana minuta: a*, dorsal view; *b*, eyes enlarged; *c*, sagittal view of copulatory apparatuses, female above. *d*, *e*, *Notoplana micronesiana: d*, dorsal view; *e*, eyes enlarged. (Explanation on page 597.)

cular coat, forming a bulbous vagina. This is slanted almost horizontally forward. The vagina then narrows to an apparently sinuous duct but parts here were not as clear as desirable. This sinuous duct receives numerous cement glands; it gradually ascends and finally curves posteriorly. After receiving from below the common oviduct it descends posteriorly to terminate in a small pyriform Lang's vesicle.

The entire Eniwetok specimen (USNM 28670) was sectioned but the sections proved unsatisfactory. As far as it could be discerned the female apparatus resembled that of the Ifaluk specimen, having a bulbous vagina followed by an apparently sinuous glandular section of the vagina, but this again was not clear. The male apparatus could not be followed satisfactorily and was deficient in the same area as the Ifaluk specimen. One point was definite; the two gonopores are close together and the male antrum ascends immediately in front of the vagina. This may represent a geographic difference between the two specimens; or the two specimens may represent different species of *Stylochoplana*. The condition of the sexual apparatus of the Eniwetok specimen does not justify describing it as a distinct species, hence it is doubtfully assigned to *Stylochoplana minuta*.

DIFFERENTIAL DIAGNOSIS: *Stylochoplana minuta* is dintinguished by the small size at sexual maturity, arrangement of the eyes in a single row on each side, bulbous vagina, and sinuous course of the glandular vagina.

HOLOTYPE: USNM 28642. Anterior part of the Ifaluk specimen as whole mount, postpharyngeal region as sagittal serial sections (one slide).

Notoplana micronesiana, new species

FIGURES 2*d*,*e*; 3*a*

MATERIAL: One specimen washed from algae in the intertidal zone, Sept. 4, 1953, Ifaluk Atoll, near south end of Falarik Islet, Sta. 23–E–1.

GENERAL FEATURES: The worm is 18 mm. long, 3 mm. wide, of elongated slender shape with rounded anterior end, blunt posterior end (fig. 2*d*). Probably white in life, it was pale brown preserved. The eyes (fig. 2*e*) are arranged in a continuous band on each side and are not definitely delimited into cerebral and tentacular clusters. In the cleared specimen scarcely anything could be seen of internal structures. The pharynx was vaguely indicated as shown in figure 1*d*, but sexual structures were not detectable. However, the postpharyngeal region was removed and sectioned sagittally; it was found to contain fully developed copulatory apparatuses.

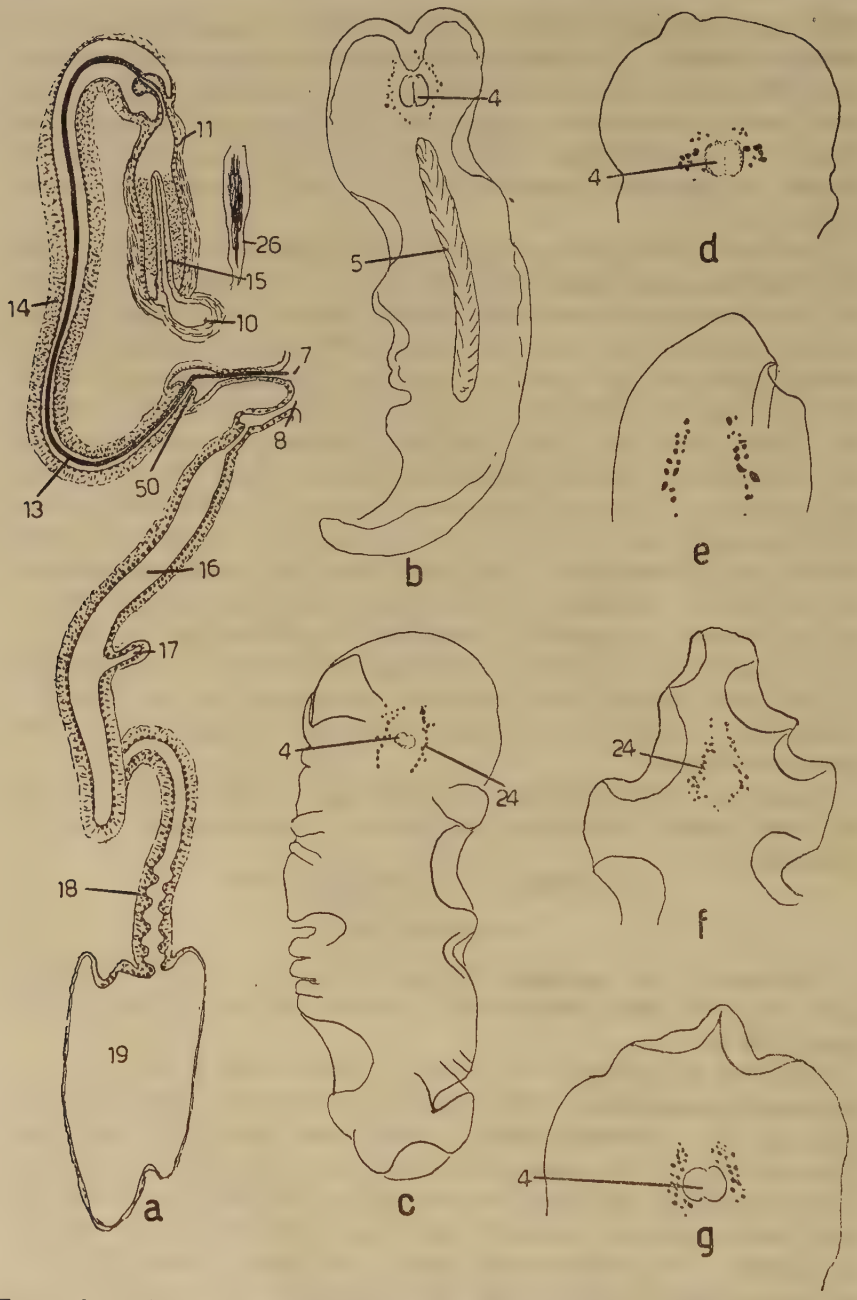

FIGURE 3.—*a*, *Notoplana micronesiana*, copulatory apparatuses, male apparatus above; *b*, juvenile leptoplanid from Ifaluk Atoll; *c*, juvenile leptoplanid from Majuro Atoll; *d–g*, juvenile leptoplanids from the Palau Islands. (Explanation on page 597.)

COPULATORY APPARATUS: This is shown in sagittal view in figure 3*a*. The two gonopores are very close together. The male apparatus contains an excessively long penis stylet, represented as solid in the figure, although actually hollow. From the male gonopore the male antrum ascends dorsally as a tubular canal, widens slightly to accommodate a penis sheath, then curves slightly backward, continuing to ascend, and then turns anteriorly as a long narrow canal with a thick muscular investment. Anteriorly it gradually widens, then curves ventrally to a slightly widened chamber that houses the small penis papilla from which the very long stylet springs. The stylet occupies the whole of the very long male antrum and even protrudes from the gonopore. Extending posteriorly from the penis papilla in a horizontal plane is seen the oval prostatic vesicle into which the ejaculatory duct projects as diagnostic of the genus *Notoplana*. Proximally the prostatic vesicle is entered by a small oval seminal vesicle with the usual muscular wall.

The female apparatus is also long and tubular. The short tubular female antrum ascends from the female gonopore, then widens to a vagina that slants dorsally and posteriorly. It is lined by a cuboidal epithelium and has a good muscular investment. After receiving from below the common oviduct, the vagina continues unaltered as a long duct of Lang's vesicle that makes an S turn, then proceeds posteriorly to enter the oval, thin-walled Lang's vesicle of moderate size.

DIFFERENTIAL DIAGNOSIS: Of the many species of *Notoplana* few are provided with a long penis stylet. The stylet of the present species seems to exceed that of all others in relative length. The eye arrangement and proximity of the gonopores also differentiate *Notoplana micronesiana* from other long-styletted species of the genus.

HOLOTYPE: USNM 28643, anterior part as whole mount, copulatory region as sagittal serial sections (one slide).

Euplana gigas (Schmarda, 1859)

REMARKS: This is one of the most common and widely spread of Indo-West Pacific polyclads and is easily recognized by the characteristic color pattern, which has been excellently figured in color by Laidlaw (1902) and Kato (1934). This species was previously discussed (Hyman, 1955b), and hence comment here will be limited to distributional records. Four specimens (USNM 28644) were collected by D. H. Johnson on Oca Point, Guam, June 26, 1945. The largest of these was 90 mm. long, preserved, with the gonopores 15 mm. apart. Five specimens (USNM 28645–USNM 28647) were collected by Cadet Hand, July 2, 31, and Aug. 2, 1954, at Kapingamarangi Atoll, at the southern border of the Caroline Islands. These are new records for the species but there is little doubt that this polyclad is spread through-

out the Indo-West Pacific from the coast of Africa to Japan and Polynesia.

Juvenile Leptoplanidae

FIGURE 3*b–g*

Many of the specimens in the material were juvenile leptoplanids, hence not identifiable. One specimen (USNM 28671), collected by Reish from algae on Majuro Atoll, Sta. E–57, Aug. 30, 1956, might possibly be *Stylochoplana minuta*, as judged by the eye arrangement (fig. 3*c*); this worm is 3 mm. long with 18 eyes on one side, 19 on the other. Most of the specimens collected at Ifaluk Atoll in the Caroline Islands were juvenile leptoplanids, apparently all of one species, that, judged by the eye arrangement, are probably either *Notoplana micronesiana* or *Stylochoplana minuta*. Apparently at the time of collecting, September–October 1953, some common leptoplanid of the atoll had been breeding. These baby leptoplanids were washed from algae in the intertidal zone at Stations 29–B–3, 32–F–5, 39–E–4, 40–F–3, 84–E–5, 85–G–2, 142–F–3, and 179–184–N–4. Figure 3*b* gives the general appearance of these young leptoplanids; this one came from Sta. 39–E–4 and has been returned to the U. S. National Museum as a whole mount (USNM 28677). The others (USNM 28678–USNM 28684) have been returned in the original vials.

There were five other juvenile leptoplanids (USNM 28672–28676) in the collection made by the Stanford team in the Palau Islands. As judged by the eye pattern, none of these is identical with *Notoplana palaoensis* Kato (1943), the only mature leptoplanid reported from the Palau Islands. USNM 28672, collected from Sta. 28, July 21, 1955, is 3 mm. long, pale or white, anteriorly expanded, with a few eyes arranged in tentacualr and cerebral clusters (fig. 3*d*). USNM 28673, from Sta. 47, July 28, 1955, is 2.3 mm. long, dark gray in color, of slender shape, with eyes in two longitudinal bands (fig. 3*e*). USNM 28674, from Sta. 60, Aug. 5, 1955, is 2.8 mm. long, of slender ruffled form, probably white, with eyes in two bands (fig. 3*f*). USNM 28675, taken Oct. 12, 1955, at Sta. 220, is 3.5 mm. long, pale, of broad, elongated form with eyes in two somewhat broad bands (fig. 3*g*); traces of incipient copulatory organs are present. The eye arrangement somewhat resembles that of the specimen from Sta. 47 (fig. 3*e*), but the difference in color precludes identity. USNM 28676, from Sta. 258, Nov. 2, 1955, appears definitely identical with the one from Sta. 60 (fig. 3*f*) and has not been figured; it is 4 mm. long, white, thin and ruffled. Tentacles appeared absent in all cases and the usual central elongated ruffled pharynx is present. All have been returned to the U. S. National Museum as whole mounts.

It is puzzling that the collections contain so many juvenile leptoplanids and so few adult ones. It further appears that a number of distinct species of Leptoplanidae must be present around the Palau Islands.

Family Planoceridae Lang, 1884

Aquaplana pacifica, new species

Figures 4*a–c*; 5*a*

Material: One specimen collected by the Stanford team at Sta. 220, Palau Islands, southeastern end of Koror Island in Oyster Pass, near east entrance of Iwayama Bay, Oct. 12, 1955.

General characters: The specimen is of broadly oval form (fig. 4*a*), measuring 14 by 11 mm., and of a transparent texture but peppered with minute brown dots that are very abundant over the copulatory region but diminished over the pharyngeal area. There are two tentacles, contracted to rounded form, that contain no eyes but are also peppered with brown dots. The numerous eyes occur in paired tentacular clusters and in a loose cerebral group that is not very definitely paired (fig. 4*b*). From the central ruffled pharynx narrow intestinal branches radiate to the periphery, and a main intestinal branch extends anteriorly, subdividing into three. The uteri, stuffed with eggs, begin just behind the tentacles and curve posteriorly lateral to the pharynx, converging to the female copulatory apparatus. The copulatory apparatuses are found somewhat posterior to the pharynx, and because of the transparency of the animal show many details prior to sectioning (fig. 4*c*).

Copulatory apparatus: The copulatory region was removed and sectioned sagittally, and the apparatuses are shown in sagittal view in figure 5*a*. All parts of the male apparatus are bound within the same muscular sheath (fig. 4*c*). The spermiducal vesicles (expanded sperm ducts) approach the male apparatus from behind, and at its sides acquire a thick coat of circular fibers, thus becoming spherical spermiducal bulbs. Their muscle fibers are continuous with those of the rest of the male apparatus (fig. 4*c*). Prostatic vesicle and cirrus sac form one continuous structure with a continuous muscle coat. The anterior end of this structure constitutes the prostatic vesicle, not demarcated from the cirrus sac. It has a thick muscular coat of fibers that mostly parallel its external contour and the relatively small pyriform cavity is lined by ridges of glandular epithelium, filled with eosinophilous granules. The prostatic duct continues posteriorly as the ejaculatory duct, centrally placed in the cirrus sac. This duct shortly receives the short common sperm duct into its ventral side (fig. 5*a*), formed by the union of the two sperm ducts.

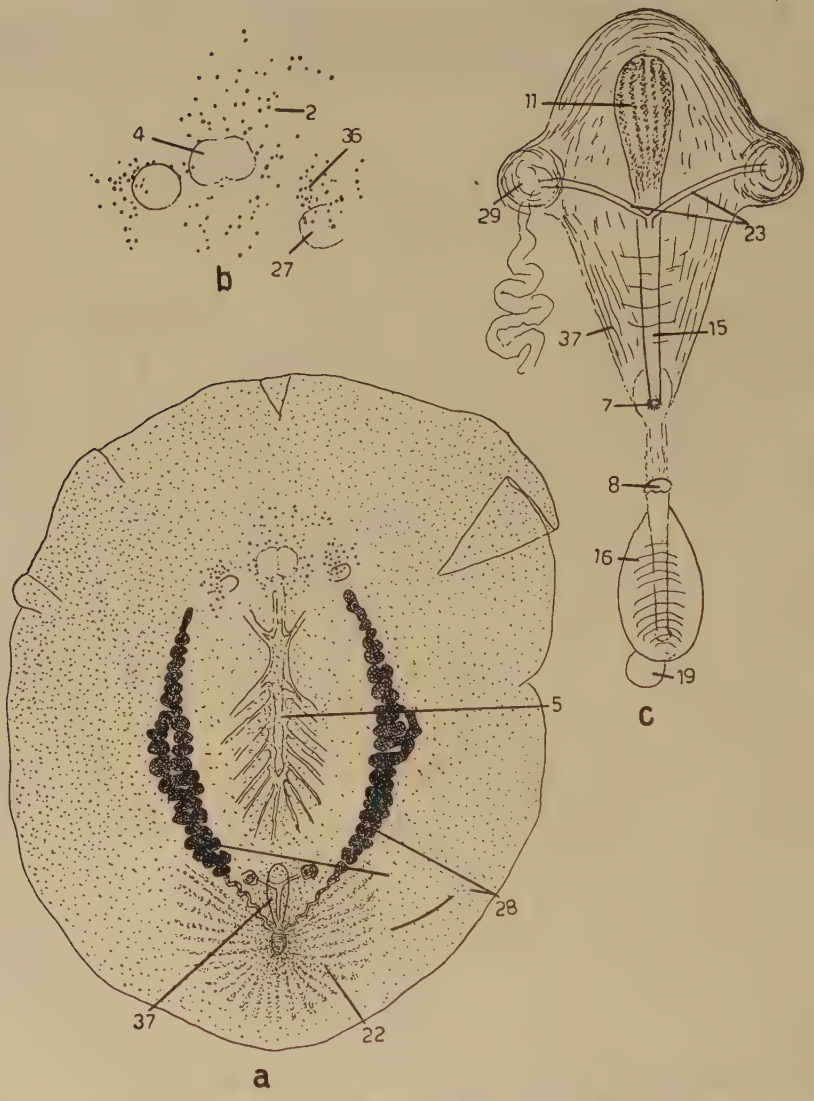

FIGURE 4.—*Aquaplana pacifica: a*, dorsal view; *b*, eyes enlarged; *c*, copulatory apparatuses as seen looking down on whole animal. (Explanation on page 597.)

These course separately from the spermiducal bulbs through the thick muscular wall of the cirrus sac. The cirrus sac is of elongated conical form, gradually narrowing to the male gonopore. Posteriorly its wall continues as a cirrus papilla, armed with a few teeth, that projects posteriorly beyond the male gonopore and is basally enclosed in a short male antrum. There is no other armature of the male apparatus except the teeth or thorns on the cirrus papilla.

The female gonopore, located shortly behind the male gonopore and almost reached by the protruding cirrus papilla, leads into a vertical female antrum from which the long vagina slants anteriorly, paralleling the cirrus sac, then curves backwards and descends towards the ventral body wall. The ascending part of the vagina is glandular, lined by a tall epithelium that receives the numerous cement glands. Shortly after curving backward, the vagina alters into a strongly muscular tube with a cuticularized lining. The thick muscular wall of interwoven muscle fibers pursuing a mostly circular course is well delimited from the surrounding mesenchyme. After turning downward, the vagina again alters its histological character, losing the definite muscular coat and becoming lined with a tall cellular epithelium. As it continues to descend, the vagina enlarges into a sac that receives into its anterior wall the common oviduct; it then narrows again as the duct of Lang's vesicle that makes an upward bend and terminates in a small oval Lang's vesicle (fig. 5*a*). A copulatory bursa is wanting.

DIFFERENTIAL DIAGNOSIS: *Aquaplana pacifica* differs from the only other species of the genus, *A. oceanica* (Hyman) (1953b), in the lack of a copulatory bursa and the much smaller size of Lang's vesicle.

HOLOTYPE: USNM 28648, one whole mount with copulatory region removed, the latter as sagittal sections (three slides).

REMARKS: There is good correspondence between the general and copulatory anatomy of the two species of *Aquaplana*. In *A. oceanica* the spermiducal bulbs and prostatic vesicle are not quite as closely incorporated with the cirrus sac as in *A. pacifica*. In both species the vagina is differentiated into glandular and muscular regions. The want of a copulatory bursa in *A. pacifica* seems to indicate that this structure is not as taxonomically important as previously supposed. Its lack in *A. pacifica* would certainly not warrant separating the latter into a distinct genus. The important character of the genus appears to be the cirrus papilla armed with thorns. In *A. oceanica* thorns are also present on the wall of the male antrum but these are wanting in *A. pacifica*.

Paraplanocera fritillata, new species

FIGURES 5*b–d*; 6*a*

MATERIAL: One specimen taken by Reish from rocks on the reef flat at Eniwetok Atoll, Sta. E–123, Sept. 7, 1956.

GENERAL CHARACTERS: The specimen (fig. 5*b*) is of broadly oval form, measuring 19 by 17 mm., of thin, transparent texture, with ruffled margins. The color is yellowish gray, slightly mottled with brown, and under magnification a cloud of black dots is seen over

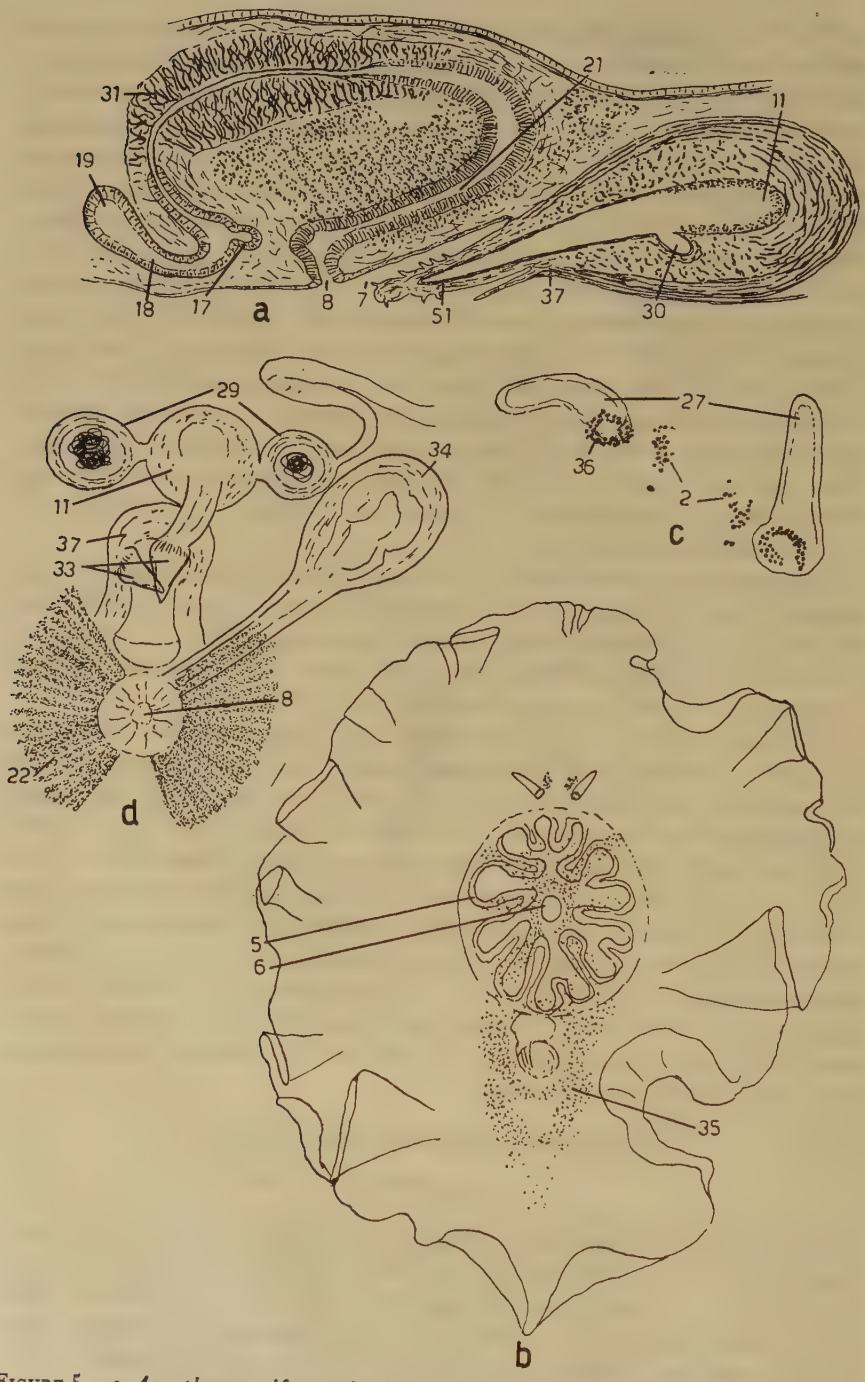

FIGURE 5.—*a*, *Aquaplana pacifica*, sagittal view of copulatory apparatuses, male apparatus to right; *b–d*, *Paraplanocera fritillata: b*, entire animal; *c*, eyes and tentacles enlarged; *d*, copulatory region as seen from ventral side in cleared animal. (Explanation on page 597.)

and around the central organs (pharynx, copulatory apparatuses). Sections show that these dots are located in the mesenchyme and are aggregations of minute black granules. Similar dots are recorded for *P. langii* (Laidlaw) (1902) and *P. rotumanensis* Laidlaw (1903a). There is a pair of elongated tentacles situated far back from the anterior margin. At the base of each tentacle is a circle of densely placed eyes and between the tentacles are two cerebral groups of eyes, of 20–25 eyes each (fig. 5*c*). The rounded ruffled pharynx with central mouth is medially located, slightly anterior to the body center. Behind it appears the copulatory apparatus, of which the main parts are easily seen because of the transparency of the body. There are seen (fig. 5*d*) the round spermiducal bulbs with thick muscular wall of circular fibers to either side of the prostatic vesicle, the cirrus sac with two large teeth, pyriform copulatory bursa extending anteriorly to one side of the male complex, and the vagina surrounded with a halo of cement glands. The copulatory region was removed and sectioned sagittally and the remainder of the worm mounted whole.

COPULATORY APPARATUS: A sagittal view of the apparatus appears in figure 6*a*. The rounded prostatic vesicle forms the anterior end of the male apparatus; it has a moderately thick wall of muscle fibers paralleling its external contour and a glandular interior composed of glandular folds projecting into the lumen and composed of eosinophilous granules. The two accessory prostatic vesicles or pockets found at the posterior side of the main vesicle and very definitely marked off in some species, notably *P. oligoglena*, are here poorly defined, although apparently present. A wide prostatic duct leaves the prostatic vesicle and receives at once a relatively long common sperm duct into its ventral side. The spermiducal bulbs as they approach the prostatic vesicle have a firm muscular coat of circular fibers that is much thicker on the side towards the vesicle and soon becomes incorporated into the muscular coat of the latter. Each spermiducal bulb then narrows to a sperm duct, still with a coat of circular fibers, that soon joins its fellow to produce the common sperm duct. The common sperm duct enters the prostatic duct from below just as the latter leaves the prostatic vesicle. The right spermiducal vesicle does not coil extensively in front of the bursa as it does in *P. oligoglena*.

The prostatic duct with ciliated epithelial lining, thin but muscular dorsal wall, and thicker muscular ventral wall, curves posteriorly above the anterior part of the cirrus sac and enters the dorsal wall of this sac at about its middle. The cirrus sac is an oval body with excessively thick muscular wall. The muscles run mostly at right angles to the external contours but actually a web of fibers is present. Into the lumen of the anterior part of the cirrus sac there projects a

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very large tooth covered with a cuticularized coat; at its base a small tooth is seen on each side but no other teeth were evident in the anterior part of the sac. At about the middle there is another similar large tooth with cuticularized surface and distal to this the lumen is lined with small teeth that increase in size distally to the beginning of the male antrum proper. The antrum is a tubular exit lined by a tall epithelium; its anterior wall forms a pair of glandular pouches that receive eosinophilous secretion. Prostatic duct and anterior part of the cirrus sac are surrounded by a so-called space that is filled with a vague bluish material in stained sections. It seems to be present in all members of the genus.

The female gonopore is well separated from the male pore. It leads into a short tubular female antrum from which the wider vagina with much folded walls ascends. Characteristic of the present species are two strongly marked cement pockets of the vagina, an anterior and a posterior one. Each receives a great cloud of cement glands. The posterior pocket is the larger of the two, although this is not evident in the median section, since it expands laterally, and receives the greater mass of cement glands. Dorsal to the entrance of these cement pockets, the vagina receives the copulatory bursa from in front, then proceeds dorsally and curves posteriorly above the posterior cement mass. At this point it receives separately the two oviducts (not shown in the figure), then descends as the duct of Lang's vesicle and opens into the relatively short Lang's vesicle. The female tract of these parts is lined by a cuboidal to tall epithelium and is rather muscular at first; the muscular investment declines towards Lang's vesicle which has scarcely any muscular fibers outside the epithelium.

The copulatory bursa, not further illustrated, is an extremely muscular pyriform sac that extends anteriorly from the vagina along the right side of the male apparatus to the level of the right spermiducal bulb. The immensely thick muscular wall of a web of muscle fibers gradually diminishes in thickness towards the blind end of the bursa and concomitantly the lumen, which does not seem to be lined by a definite epithelium, enlarges. At the proximal end of the bursa, the wall is relatively thin, although still muscular, and the lumen quite large. The wall is everywhere greatly folded into the lumen. The interior, especially proximally, contains a great mass, presumably sperm, but so dense this cannot be determined certainly.

Differential diagnosis: This is the ninth species to be assigned to the genus and the question of the validity of these species remains baffling. The matter of validity was discussed by Kato (1936), Prudhoe (1945), and Hyman (1953a); Prudhoe, especially, was inclined to reduce the number of species by throwing most into synonymy with *P. oligoglena*. But it now appears to me that insufficient

attention has been paid to the available details about the species. In view of the unsatisfactory nature of some of the descriptions and the failure to mention certain points, especially the presence or absence of accessory prostatic vesicles and antral glands of the male apparatus, it seems to me we are not in a position to declare definitely that any one of the species is synonymous with any other.

I am reluctant to add another species to this complicated situation but I am not able to identify my form with any of the previously described species. The present specimen resembles *P. oligoglena* in color and in the presence of two very large teeth in the cirrus sac but differs in the fewer cerebral eyes, the cloud of black dots middorsally, the entrance of the common sperm duct into the prostatic duct, not into the prostatic vesicle, the poor differentiation of the two accessory prostatic vesicles, the extreme differentiation of the two cement pouches, and the shorter Lang's vesicle. The conspicuous coils of the right spermiducal vesicle in front of the bursa, typical of *P. oligoglena*, are wanting.

The cloud of black dots in the middorsal region appears to be a very definite character. It can scarcely be overlooked as it is noticeable at once on low magnification. These dots, as already mentioned, are in the mesenchyme. They are not the same as the dots in the intestinal branches mentioned by several authors. It appears that such dots are recorded only for *P. langi* (Laidlaw) (1902) and *P. rotumanensis* Laidlaw (1903a). *P. langi* is described as white, with "two" cerebral eyes, cylindrical tubular cirrus sac lined throughout with spines, short wide prostatic duct receiving the common sperm duct, and two "folds" in the cirrus sac. If in fact *P. langi* regularly has only two cerebral eyes this would differentiate it from all other species of the genus. The number of cerebral eyes is of course somewhat variable among individuals of the same species but not to that extent. It is not clear just what is meant by the folds in the cirrus sac, but apparently they are not teeth. The description of *P. rotumanensis* is even less satisfactory. The cerebral eyes are rather numerous, divided into two groups on each side, the intestine gives off dorsal diverticula containing brown spots, the prostatic duct enters the cirrus sac on the VENTRAL side, the lumen of the cirrus sac is lined throughout with spines, two folds like those of *P. langi* are present, the common sperm duct enters the prostatic duct, and Lang's vesible is rather large and long. It appears impossible to reconcile *P. fritillata* with either of these descriptions. It has a fair number of cerebral eyes, scarcely divided into two groups on each side, the cirrus sac is thick and oval, not tubular, the prostatic duct is rather long and enters the cirrus sac in the middle of its DORSAL surface, the lumen of the cirrus sac rather lacks spines anteriorly, the two very large

teeth are definitely not folds, and Lang's vesicle is rather short. The descriptions of *P. langi* and *P. rotumanensis* do not mention the presence of accessory prostatic vesicles or male antral glands but these structures cannot be presumed to be absent. *P. fritillata* appears to differ from previously described species of the genus in the very strongly differentiated cement pockets, one from the anterior, the other from the posterior side of the vagina. There is no pocket associated with the entrance of the bursa into the vagina as described for *P. misakiensis* Yeri and Kaburaki (1918). These cement pockets, the cloud of black dots, the poor differentiation of the accessory prostatic vesicles, the lack of spination of the anterior part of the cirrus sac, and the short Lang's vesicle may be taken to characterize *P. fritillata*.

HOLOTYPE: USNM 28649, one whole mount with copulatory region removed and sectioned (four slides).

Family CALLIOPLANIDAE Hyman, 1953

Asolenia, new genus

DEFINITION: Callioplanidae without Lang's vesicle; reduced female tract enters the roof of the male antrum; male copulatory apparatus as in *Callioplana*. Type species: *Asolenia deilogyna*.

Asolenia deilogyna, new species

FIGURE 6*b*,*c*

MATERIAL: One specimen collected from algae at the Palau Islands by the Stanford team July 22, 1955, Sta. 30.

GENERAL CHARACTERS: This is a very small worm, 2.5 mm. long, colorless, without tentacles, of a moderately elongated shape (fig. 6*b*). The eyes are rather few in number, arranged in an arc of about a dozen eyes on each side (fig. 6*b*); in this arc, four larger eyes on each side probably represent tentacular eyes. The central ruffled pharynx is encircled anteriorly by the confluent uteri, filled with eggs, and ovaries are seen scattered in lateral regions. At first the specimen was thought to be a juvenile leptoplanid but then the uteri were noticed, evidencing sexual maturity.

COPULATORY APPARATUS: Because of its small size the entire worm was sectioned sagittally. Examination of the sections revealed surprisingly a member of the family Callioplanidae. A sagittal view of the copulatory complex is given in figure 6*c*. The male complex is well developed and clearly shown on the sections. The oval free prostatic vesicle with muscular wall of moderate thickness and glandular eosinophilous interior is in contact on its ventral side with an elongated, oval seminal vesicle with muscular wall. The duct of the

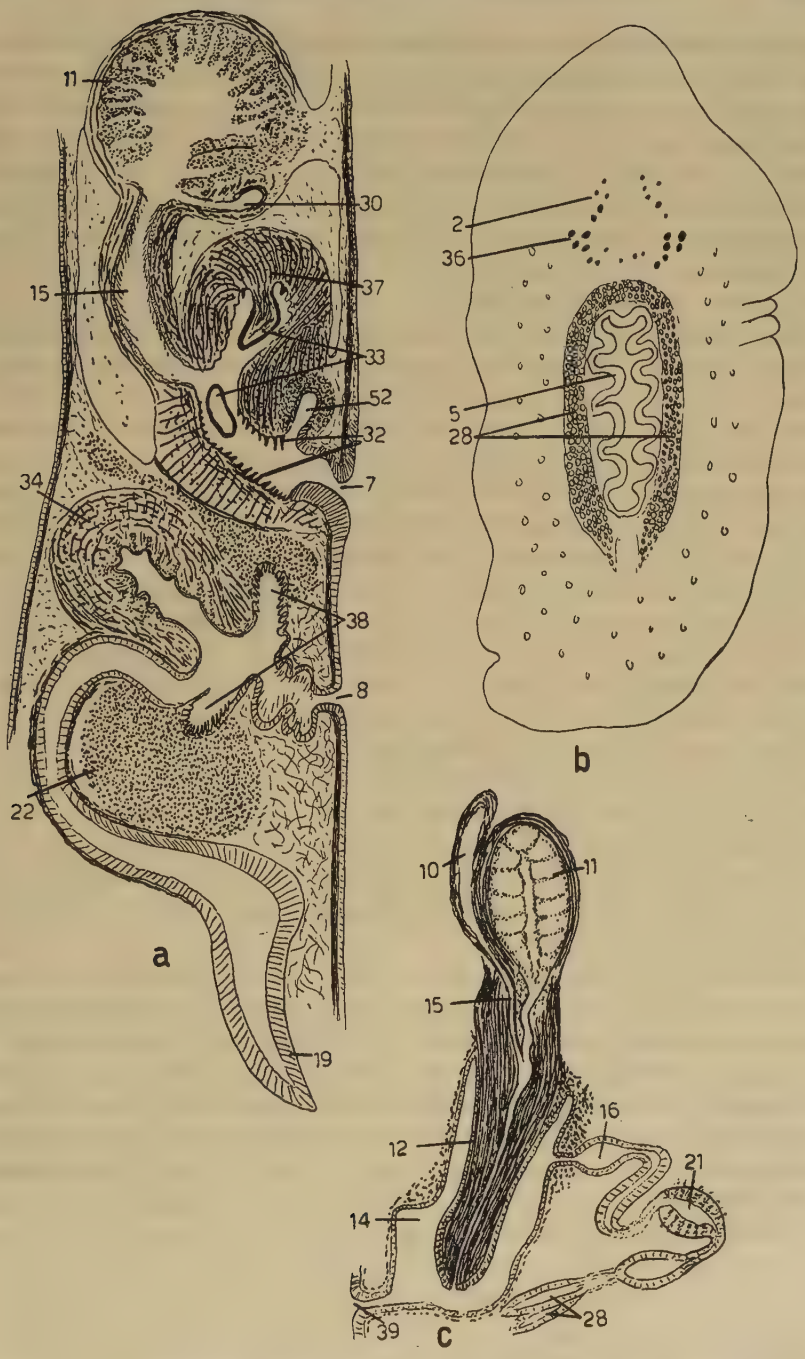

FIGURE 6.—*a*, *Paraplanocera fritillata*, sagittal view of copulatory complex, male above. *b*, *c*, *Asolenia deilogyna*: *b*, entire animal; *c*, sagittal view of copulatory complex, male above. (Explanation on page 597.)

prostatic vesicle and the ejaculatory duct of the seminal vesicle meet and unite in the proximal part of the penis papilla and the common duct so formed extends along the center of the penis papilla to its tip. The penis papilla is an elongated structure with a thick muscular wall covered with an epithelium that is thickened at the penis tip and proximally becomes continuous with the lining epithelium of the rather spacious male antrum, which exits ventrally by a narrow tubular passage. Under the epithelium of the male antrum is found a considerable muscular investment.

The female apparatus is very curious, much reduced, and springing from the roof of the male antrum, something quite unusual in polyclads. This condition could hardly result from contraction on preservation. The female antrum as it leaves the male antrum is a narrow tube encircled by a thick muscular sphincter. The parts of the female tract are unfortunately poorly preserved in the sections. The antrum widens to an ascending vagina that then descends as a tube with a wall of cuboidal cells. This seems to make a curve and ascend but preservation was poor here. There next comes an oval glandular part of the vagina, definitely seen, entered by cement glands. A narrowed tube leaves this and descends, then widening to a sac that seems to receive two ducts; the connection with these ducts could not be followed although very probably it is as shown in the figure. These two ducts descend behind the male antrum and then curve anteriorly. They seem to be the uteri and could be followed, although not too clearly, to the rear ends of the egg-filled uteri shown in figure 6*b*. It is possible that the two ducts are the double Lang's vesicle characteristic of the genus *Callioplana*, but in that case the uteri would enter the vagina beyond the glandular region and no indication of ducts here could be found.

Holotype: USNM 28686, one set of sagittal sections (one slide).

Remarks: Since the female tract was unclear, it was difficult to make a decision about this worm. If the two ducts discussed above are Lang's vesicles rather than uteri, the specimen could be fitted into the genus *Callioplana*, with which the male system is in accord although the lack of tentacles and the characters of the female system disagree with the two known species of that genus: *C. marginata* (Stimpson) (1857) and *evelinae* (Marcus) (1954). The matter cannot be decided until better material is obtained.

Section Emprosthommata

Family Cestoplanidae

Juvenile Cestoplanid

Remarks: There was present in the material from Ifaluk Atoll one very juvenile cestoplanid, collected Oct. 1, 1953, from the reef ridge at the north end of Falarik. A drawing was not made. It may be recalled that a juvenile cestoplanid was previously reported from the same general area (Hyman, 1955b), but in view of the immaturity of both specimens a specific comparison is impossible. The specimen is deposited in the U. S. National Museum.

Suborder Cotylea

Family Pseudoceridae Lang, 1884

Genus *Pseudoceros* Lang, 1884

Remarks: The genus *Pseudoceros* is one of the largest polyclad genera, comprising at present over 100 valid species. The genus is easily recognized by the combination of smooth dorsal surface, tentacles as upfolds of the anterior margin, and ruffled pharynx. The species, however, are distinguishable mainly on shape and color pattern and the one is distorted and the other often totally lost in preserved specimens. Hence the identification of preserved specimens usually offers formidable difficulty. Whether the male apparatus is single or paired is a useful character and details of the male copulatory apparatus may be of value in specific diagnoses. It now appears that the shape of the pharynx may be decisive. In most species the pharynx has a compact outline but several species are now known in which the pharynx takes what I have termed the butterfly shape, putting out lateral lobulations that increase in length in the anteroposterior direction as in figure 10, c.

In 1950 Marcus published a useful list of the described species of the genus. In the thought of increasing the usefulness of this list I here add some old species overlooked by Marcus and the species described since that date: *fulminatus* (Stimpson) (1855), *guttatomarginatus* (Stimpson) (1855), *interruptus* (Stimpson) (1855), *albicornis* (Stimpson) (1857), *coccineus* (Stimpson) (1857), *japonicus* (Stimpson) (1857), *niger* (Stimpson) (1857), *affinis* (Kelaart) (1858), *atraviridis* (Kelaart) (1858), *dulcis* (Kelaart) (1858), *fuscus* (Kelaart) (1858), *purpureus* (Kelaart) (1858), *luteus* (Plehn) (1897), *izuensis* Kato (1944), *nipponicus* Kato (1944), *evelinae* Marcus (1950), *mopsus* Marcus (1952), *bajae* Hyman (1953a), *canadensis* Hyman (1953a), *mexicanus* Hyman (1953a), *montereyensis* Hyman (1953a), *coralliferus* Hyman (1954), *micronesianus* Hyman (1953b), and *texanus* Hyman (1955c).

I am of the opinion that *Pseudoceros gratus* Kato (1937, also 1943) is identical with *Eurylepta striata* Schmarda (1859). To be sure, the former is described as white with black stripes and the latter as buff with dark brown stripes but the identity of size, shape, and color pattern outweigh such slight color differences which can be caused by ingested food. As the name *striata* is preoccupied by *Eurylepta striata* Kelaart (1858), it appears that Kato's name *gratus* is valid. Therefore the proposal of *strigosus* by Marcus (1950) to cover the Kelaart-Schmarda homonymy is unnecessary.

The genus is characteristic of tropical and subtropical waters and appears to center in the Indo-West Pacific area.

***Pseudoceros perviolaceus*, new name**

Eurylepta violacea Schmarda, 1859, p. 27.
Pseudoceros violaceus, Stummer-Traunfels, 1933, p. 3544.
Not *Planaria violacea* Kelaart, 1858, p. 135.

REMARKS: A specimen referred to this species that was collected in the Palau Islands, July 22, 1954, was sent to the American Museum of Natural History in a lot of miscellaneous material. No other data are available. The specimen conforms satisfactorily to the original description and figure and with Stummer-Traunfels' statements made from Schmarda's specimen. The original specimen from Ceylon measured 60 by 40 mm., the present one 25 by 13, but presumably Schmarda's measurements are from life. The present specimen retains the shape depicted by Schmarda, that is, is broad across the anterior end and narrows regularly toward the posterior end. There is but a single male apparatus as discovered by Stummer-Traunfels. The violet or purple color had dissolved badly in the alcohol which was stained a reddish purple, leaving the animal of a uniform medium brown color.

It was necessary to create a new specific name for Schmarda's species as the name *violacea* is preoccupied by *Planaria violacea* Kelaart, which is a *Pseudoceros* but definitely not identical with Schmarda's species for it has a broadly oval shape and a yellow margin and middorsal stripe. It appears improbable that Schmarda's species can be a variant of *Pseudoceros velutinus* as supposed by Lang (1884, p. 540), for the shape of this is quite different although it, too, has but a single male apparatus.

The specimen is retained in the invertebrate section of the American Museum of Natural History.

***Pseudoceros bedfordi* Laidlaw, 1903**

REMARKS: This large and handsome pseudocerid is easily recognized by the distinctive color pattern, accurately depicted by Bock

(1913) and Kato (1943). The present specimen (USNM 28650)[2] was found swimming near the reef at Ifaluk Atoll, Aug. 12, 1953. Alive it was stated to be at least 100 mm. long, hence is the largest on record; preserved it measured 35 by 36 mm., having contracted strongly to a rounded shape whereas the natural shape is an elongated oval. This species was reported by Kato (1943) from the Palau Islands where it was stated to be common although surprisingly not recovered in the present material from these islands. It is also recorded from Singapore, the Philippines, and Heron Island in the Great Barrier Reef and is evidently widely spread in the western tropical and subtropical Pacific.

***Pseudoceros izuensis* Kato, 1944**

FIGURE 7*a–c*

REMARKS: One specimen was taken on a reef in the Palau Islands by the Stanford team, Aug. 8, 1955, Sta. 69, lagoon margin of reef southeast of Malakal Pass. As the original description is brief, an expanded account of the present specimen appears desirable, especially as there is some slight doubt of its identity with Kato's species.

The preserved specimen (USNM 28651) measures 22 by 16 mm. and is of broadly oval shape and thin consistency (fig. 7*a*). Kato gave the length, preserved, as 20 by 13 mm., but 60 by 28 in life. The tentacles as sketched by Bayer in life appear in figure 7*b*; their appearance in the preserved animal is shown in figure 7*c*. The ruffled pharynx had ruptured through the ventral surface. The color in life as described by F. M. Bayer, who also took a color photograph, was pale green above mottled with white and dotted with black dots, with a median ridge of sepia brown laced with white. The tentacles in life (fig. 7*b*) are sepia brown with white tips and white spots. The body is encircled by a marginal band of olive green composed of radial streaks. Preserved, the animal appears light gray dotted with black dots with a dark margin and a dark middorsal band laced with white. The radial streaks composing the marginal band are still detectable in the preserved specimen. Figure 7*a* attempts to depict the color pattern. The colors agree well with Kato's description except for the tentacles which he described as purplish and the absence of black at the extreme outer margin.

Behind the tentacles is seen the bilobed cluster of cerebral eyes (fig. 7*c*). This disagrees with Kato's statement that the eyes form a single cluster although his figure indicates a slight bilobulation. Kato figured the tentacular eyes, not well discernible in the present specimen.

[2] A photograph, in color, of this specimen was published in National Geographic Magazine, vol. 109, No. 4, p. 557, April 1956.

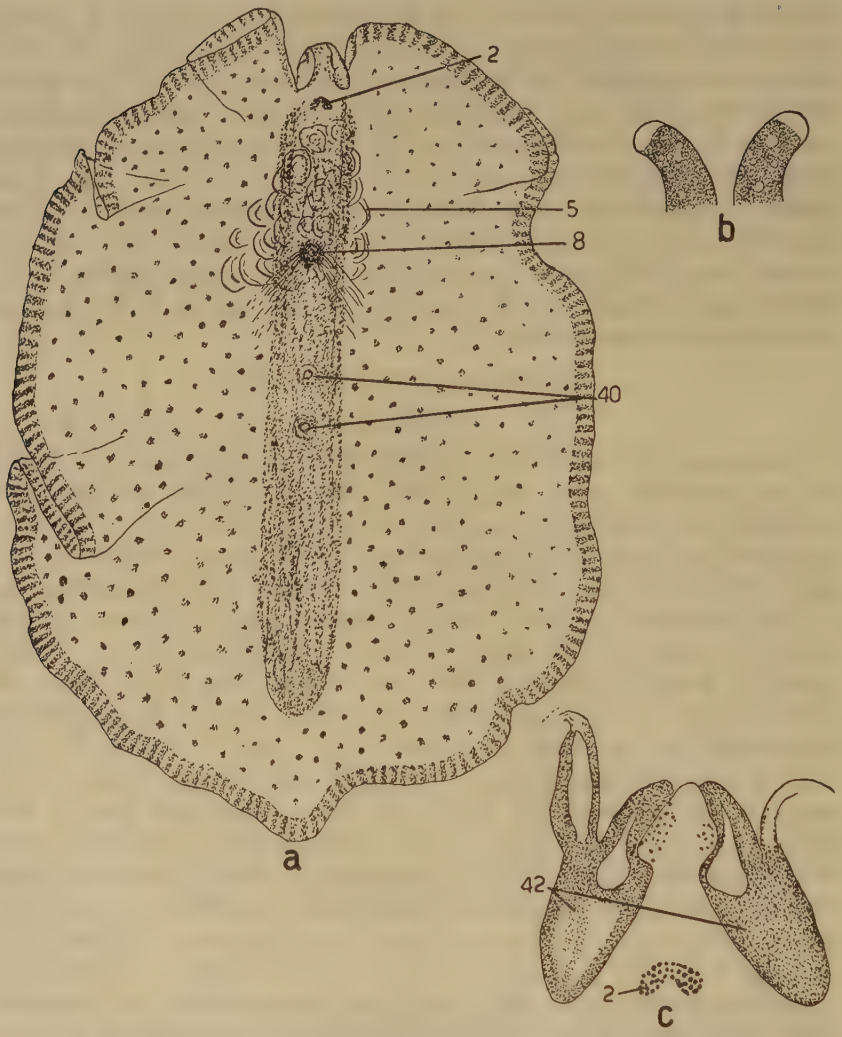

FIGURE 7.—*Pseudoceros izuensis: a*, entire animal; *b*, tentacles from life; *c*, tentacles of preserved specimen. (Explanation on page 597.)

The specimen is sexually mature but because of the rupture of the pharynx, the number of male pores could not be ascertained, although two are probably present. Kato stated a paired condition of the male apparatus. At the posterior end of the pharynx the female gonopore with accompanying cement glands is obvious (fig. 7*a*). The specimen has two suckers, one behind the other, as shown in figure 7*a*, but this is presumably an anomaly. A central position of the sucker is indicated by Kato.

The small differences mentioned above do not seem adequate grounds for separating the present specimen from Kato's species. *Pseudoceros izuensis* shows considerable resemblance in color pattern to *P. viridis* (Kelaart) (1858), Ceylon, which according to the description and colored figure in Collingwood (1876) also is green with brown tentacles, a brown middorsal stripe, and a brown streaky margin; but the dorsal surface is splotched with brown rather than dotted with black. Contrary to Lang (1884, p. 567), I think *viridis* (Schmarda) (1859) is not identical with *viridis* (Kelaart) as the color patterns of the two species appear somewhat different. It therefore is necessary to rename Schmarda's species, and I propose *virescens*.

***Pseudoceros habroptilus*, new species**

FIGURE 8

MATERIAL: One specimen taken by the Templeton Crocker Expedition, No. 1014, June 5, 1933, at Vanikoro Island, in the Solomons.

GENERAL CHARACTERS: The worm was badly crumpled and the posterior part could not be straightened. After flattening as much as possible the worm appeared as in figure 8. It measures 10 by 6 mm. and is probably of elongated oval form. At the anterior end appear the usual tentacular upfolds of which one is well preserved while the other is contracted and distorted. The tentacular eyes were poorly discernible; the single oval cerebral cluster is shown in the figure. The black-and-white color pattern is pretty and distinctive. The worm is white with a narrow, very black border that also edges the tentacular folds. Paralleling the margin is a wider band of grayish black hue and centrally there is a paired band of similar width and color. The two median bands converge anteriorly and fuse just behind the cerebral eyes. The black bands could not be followed posteriorly because of damage and crumpling here but the black margin obviously encircles the entire worm. The pharynx had probably been shed as rupture was evident ventrally at the appropriate place. The sucker was not clearly evident and is shown conjecturally in figure 8. The worm is juvenile without any traces of the reproductive system.

DIFFERENTIAL DIAGNOSIS: The color pattern is sufficiently distinctive.

HOLOTYPE: USNM 28652, the worm mounted whole.

***Pseudoceros caeruleocinctus*, new species**

FIGURE 9*a*

MATERIAL: The single specimen was taken by the Stanford team at the Palau Islands, Sta. 77, Aug. 10, 1955, crawling on clean sand in a shallow bay on the south shore of Auluptagel Island.

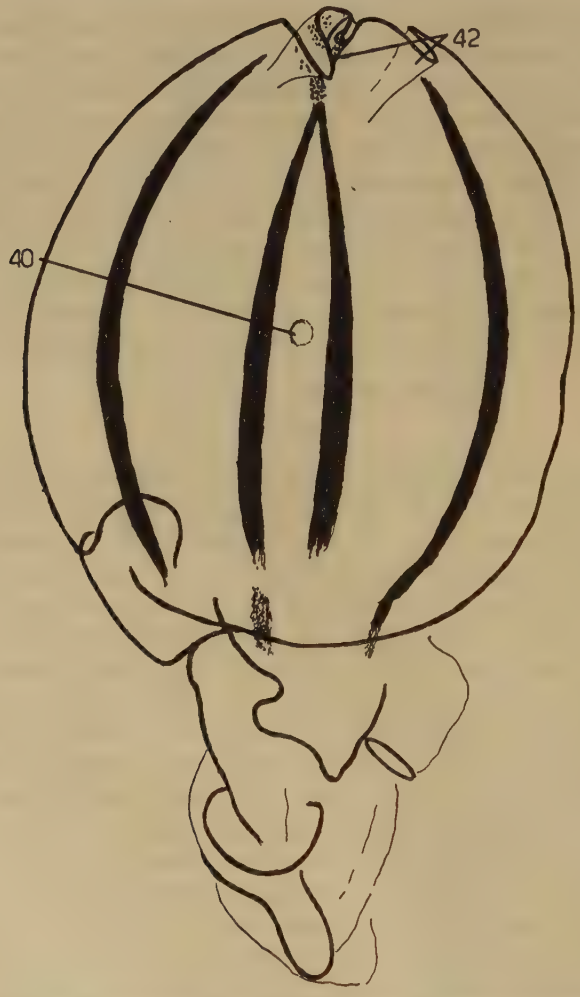

FIGURE 8.—*Pseudoceros habroptilus*, entire animal. (Explanation on page 597.)

GENERAL CHARACTERS: The preserved worm is of oblong shape, 20 mm. long by 12 mm. wide. The tentacular foldings are prominent (fig. 9*a*), but because of the black color the eyes could not be seen in the cleared worm. The color is described by the collector as velvety black with a narrow, brilliant blue border. Some trace of the blue border remains in the preserved worm. The pharynx was not detectable. There is a single male apparatus with the male pore located 5 mm. from the anterior end. The female pore occurs close behind the male pore. The sucker is located at about the body middle, 10 mm. from the anterior margin.

DIFFERENTIAL DIAGNOSIS: The blue border distinguishes this species from other black species with a colored border. This pattern, black with a narrow border of a bright contrasting color, is common among species of *Pseudoceros*, but usually the border is red, orange, or yellow, and I know of no previously described species with a blue border.

HOLOTYPE: USNM 28653, in alcohol.

***Pseudoceros ferrugineus*, new species**

FIGURE 9*b*,*c*

MATERIAL: The single specimen was taken by the Stanford team at Sta. 236A, in Iwayama Bay, Palau Islands, Oct. 20, 1955, crawling in about a meter of water on the rocky shelf of the east end of Koror Island, in Oyster Pass.

GENERAL CHARACTERS: The worm is of elongated oval shape (fig. 9*b*), measuring 18 mm. in length by 11 mm. in width, preserved. The tentacular foldings appear slightly developed, both in the preserved worm (fig. 9*c*), and on the color photograph of the live worm. The brilliant coloring in life is preserved on the photograph taken by F. M. Bayer, but, alas, the preserved worm is a dull grayish brown. In life the general color is a bright rusty red blending into a narrow margin of brilliant orange. The dorsal surface is liberally flecked with white on the rusty background and here and there these flecks fuse to form nebulous patches of clear white or tinged with pink in places. The white flecks diminish towards the margin where the rusty red background is much more in evidence. The bright orange marginal line is free from spots. There is some indication of a narrow middorsal line of pale rust that fades away posteriorly.

In the cleared worm (fig. 9*b*) there could be seen the slightly bilobed cluster of cerebral eyes (fig. 9*c*), the ruffled pharynx having the butterfly shape that I have noticed in some species of *Pseudoceros*, the pair of male pores in the concavity of the last lobulations of the pharynx, the female pore close behind the male pores, and the sucker slightly behind the middle, about 10 mm. from the anterior end.

DIFFERENTIAL DIAGNOSIS: The color pattern is distinctive.

HOLOTYPE: USNM 28654, in alcohol.

***Pseudoceros ater*, new species**

FIGURE 9*d*

MATERIAL: The single specimen was taken by the Stanford team on Raeldil reef, Palau Islands, Sta. 254, Oct. 27, 1955. It was collected at night with a light on the outer reef flat among branching corals.

GENERAL CHARACTERS: This is a small worm, measuring 9 by 7 mm. preserved, although evidently somewhat contracted, hence longer in

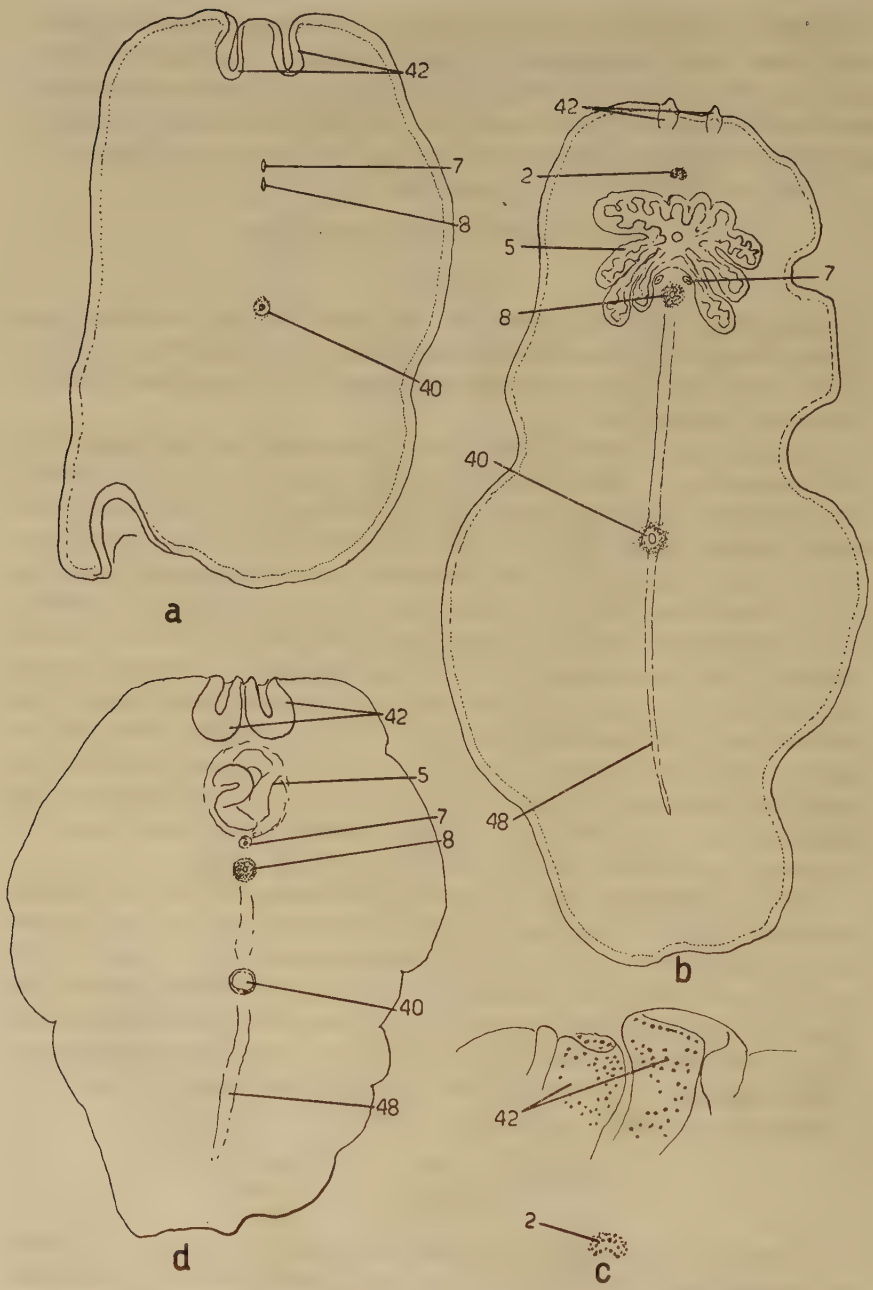

FIGURE 9.—*a*, *Pseudoceros caeruleocinctus*, entire animal. *b*, *c*, *P. ferrugineus*: *b*, entire animal; *c*, tentacles enlarged. *d*, *P. ater*. (Explanation on page 597.)

life. The form is an elongated oval (fig. 9*d*). The tentacular upfoldings are well preserved. Behind them is seen the small, compact ruffled pharynx of a few folds, and directly behind this occurs the single male gonopore, followed by the female pore. The sucker is situated somewhat posterior to the middle of the worm. Despite its small size the worm was fully mature and laid a small globular egg mass during the night in the jar in which it had been placed. The color is a uniform very dark grayish black, or practically black, without any markings. Because of the black color, eyes could not be seen.

DIFFERENTIAL DIAGNOSIS: There does not seem to be any previously described species of *Pseudoceros* that is small and uniformly of a dull black coloration. *Pseudoceros velutinus* (Blanchard) (1847) is uniformly black but the black is of a velvety texture and tinged with blue or violet; this species is further quite large, being still not fully mature at a length of 50 mm. *Pseudoceros bajae* Hyman (1953a) is also quite large, with a pair of male apparatuses.

HOLOTYPE: USNM 28655, in alcohol.

Pseudoceros fulvogriseus, new species

FIGURE 10*a,b*

MATERIAL: One specimen was taken by the Stanford team in Geruherugairu Pass, Iwayama Bay, Palau Islands, Sta. 85, Aug. 12, 1955.

GENERAL CHARACTERS: The worm is a large, elongated species, 50 mm. long, preserved, 20 mm. across the widest part. The extensive ruffling of the margins indicates a much greater length when crawling, extended. The worm appears widest across the middle and tapers from this to the rounded anterior end, with typical tentacular foldings, and posteriorly to the pointed tail (fig. 10*a*). The shape is unusually elongated for the genus. An enlarged view of the tentacular foldings is shown in figure 10*b*, which also gives the eye distribution. Shortly behind the tentacles is found the group of cerebral eyes, forming a single large rounded cluster. Behind the cerebral eye cluster is seen the compact ruffled pharynx, surprisingly small for the size of the worm. Posterior to the pharynx are the two male pores, unusually close together, located 10 mm. from the anterior end. They are followed by the female pore, 13 mm. from the anterior end. The sucker is located at about the middle, 25 mm. from the anterior end. The worm appeared in breeding condition for the branched, anastomosing uterus (shown on one side only in figure 10*a*) was very evident in the cleared specimen.

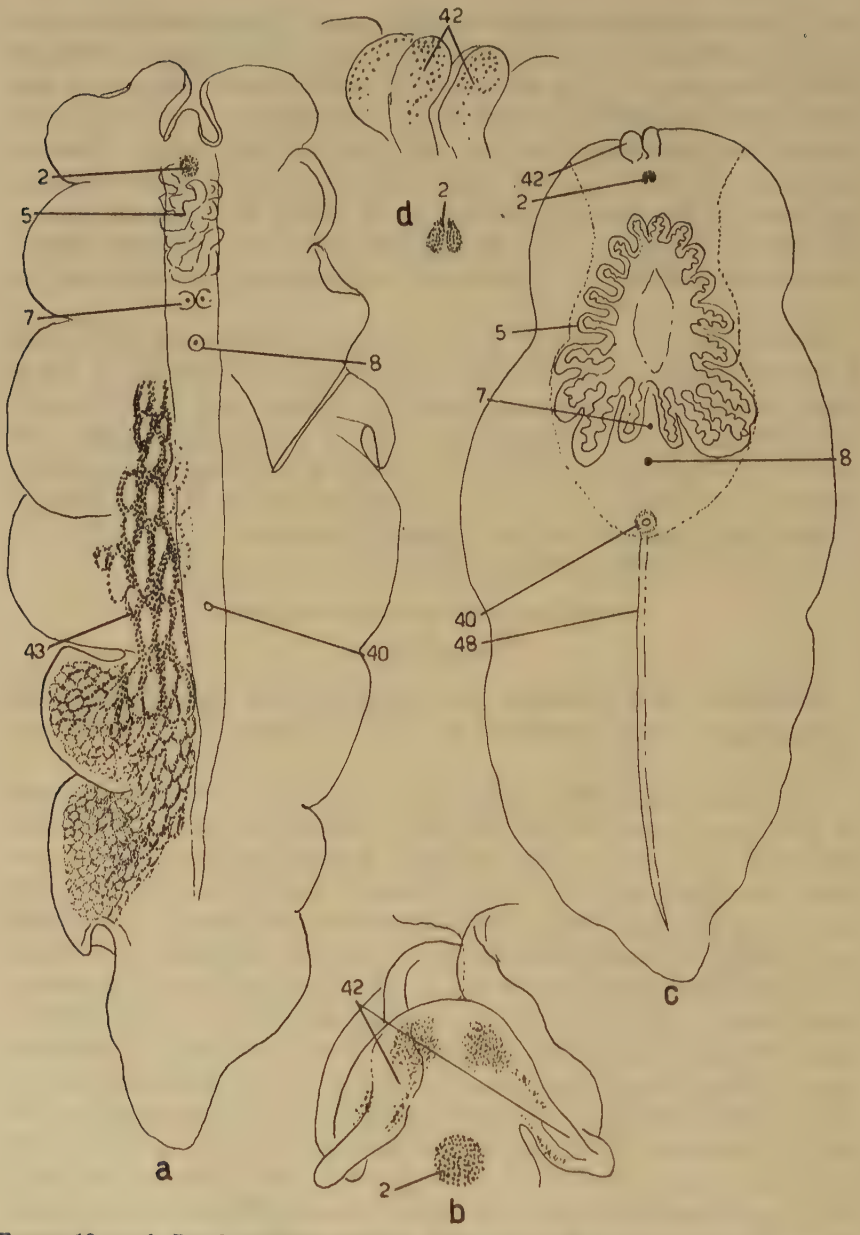

FIGURE 10.—*a*, *b*, *Pseudoceros fulvogriseus: a*, entire animal; *b*, tentacles enlarged. *c*, *d*, *P. fuscogriseus: c*, entire animal; *d*, tentacles enlarged. (Explanation on page 597.)

The preserved worm is of a uniform medium gray color, marked with dark reticulations, which probably actually are the uterine anastomoses. A color photograph taken by F. M. Bayer shows that in life

the color is light gray flushed with yellowish brown. Along the center of the median ridge there runs a narrow light line flanked on each side by yellowish brown. The yellowish brown color deepens near the margin which is edged by a very narrow light line. The tentacles appear brown edged with a light margin. There is some suspicion in my mind that the tawny brown color may be caused, at least in part, by the presence of ripe eggs in the interior.

DIFFERENTIAL DIAGNOSIS: The worm is characterized by the large size, elongated shape, small compact pharynx, and color pattern.

HOLOTYPE: USNM 28656, in alcohol.

Pseudoceros fuscogriseus, new species

FIGURE 10*c*,*d*

MATERIAL: Two specimens were collected by the Stanford team in eel grass in the channel between Peliliu and Ngedebus, Palau Islands, Sta. 37, July 25, 1955.

GENERAL CHARACTERS: The worms are of moderate size and general oval form, tapering posteriorly to a pointed tail (fig. 10*c*). The larger specimen measured, preserved, 23 by 10 mm., the smaller one, 16 by 8 mm. Both worms were bent in the pharyngeal region and ruptured there when straightened out, hence it did not appear profitable to section the copulatory region of one of them as this would probably be involved in the rupture. The anterior end of the larger specimen while cleared is shown in figure 10*d*. The tentacles, much distorted by preservation, are provided with numerous eyes and well behind them is seen the group of cerebral eyes, consisting of two oval clusters. The relatively large ruffled pharynx has the butterfly shape already mentioned in connection with *P. ferrugineus*. The single male pore is embraced by the posterior pharyngeal folds and shortly behind it is seen the female gonopore. The sucker of the larger worm is located at about 12 mm. from the anterior end. The usual middorsal ridge seen in pseudocerids is indistinct here. The main intestine could be seen in the posterior part of the worm.

Unfortunately, no information is available about the color in life but probably it was the same as in the preserved worms. They are dusky grayish brown in color with the anterior central part of a somewhat lighter shade. The extent of the light region is indicated by the dotted line in figure 10*c*. The line passes along the edge of the pharynx, slightly behind the sucker, and diverges at the anterior margin. The boundary between the lighter and darker shades of grayish brown is quite sharp.

DIFFERENTIAL DIAGNOSIS: This species lacks very definite characteristics but the combination of paired cerebral eye clusters, large

ruffled pharynx of the butterfly type, single male gonopore, and coloration should afford recognition.

HOLOTYPE: The larger specimen, USNM 28657.

Pseudoceros tristriatus, new species

FIGURE 11*a*

Pseudoceros concinnus, Stummer-Traunfels, 1933, p. 3565, fig. 9 on color pl.
Not *Proceros concinnus* Collingwood, 1876, p. 90, fig. 4, pl. 17.

MATERIAL: A single specimen was taken from beneath rocks on the seaward shore of Ella Islet, Ifaluk Atoll, western Carolines, Sept. 20, 1953, by F. M. Bayer under the auspices of the Pacific Science Board Atoll Research Program.

GENERAL CHARACTERS: The preserved worm (fig. 11*a*) is of oval form, measuring 12 by 5.5 mm., but a color photograph taken by F. M. Bayer shows that it is more elongated in life, about 4 times as long as broad. The preserved worm is entirely black but in life it is light blue with three longitudinal orange stripes. These stripes appear faintly bordered with black and extend from shortly behind the tentacles almost to the posterior end. The two lateral stripes are confluent posteriorly behind the median stripe. In the preserved worm the tentacular folds are fairly well retained and a few eyes can be seen upon them. Behind their bases is a rounded cluster of cerebral eyes but the eye arrangement could not be satisfactorily ascertained because of the dense black color of the preserved worm. The pharynx is of the butterfly type, that is, with pronounced lateral lobes increasing in length posteriorly where they slant backwards. Behind the pharynx the main intestine is conspicuous in the cleared worm, giving off numerous side branches that enter a dense black network of intestinal branches spread throughout the body. The sucker is located about 5 mm. from the anterior end in the preserved specimen. The worm is juvenile, being devoid of any traces of the reproductive system.

HOLOTYPE: USNM 28659, one whole mount.

REMARKS: Despite the immaturity of the specimen, the very distinctive color pattern justifies giving it a name. I believe this specimen is identical with the one figured in Stummer-Traunfels (1933, fig. 9 on col. pl. following p. 3596), which he identified as *Pseudoceros concinnus* (Collingwood). I believe this identification is erroneous, for Collingwood's colored figure gives an entirely different color pattern: cream with a blue border and blue middorsal stripe. I previously called attention to Stummer-Traunfels' error when I described as *P. concinnus* specimens from New Guinea (Hyman, 1954). Stummer-Traunfels' colored figure that I regard as identical with the

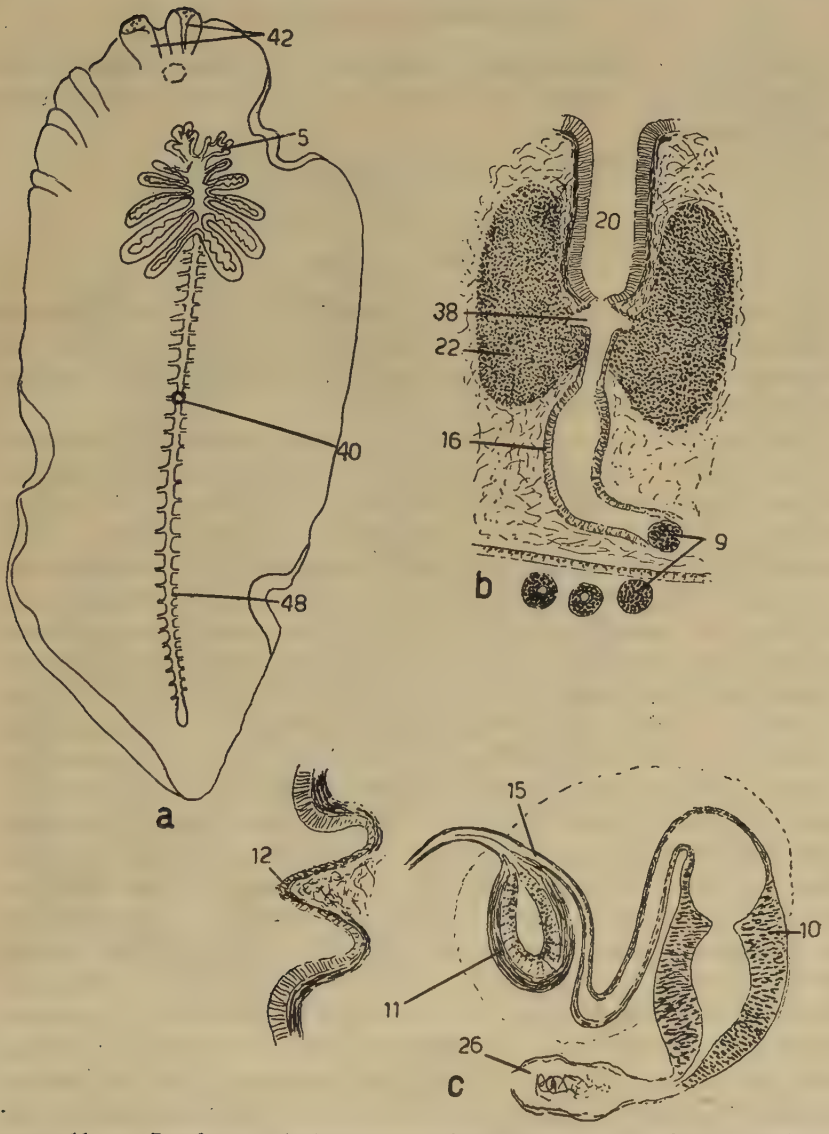

FIGURE 11.—*a*, *Pseudoceros tristriatus*. *b*, *c*, *Nymphozoon bayeri*: *b*, female copulatory apparatus, sagittal view; *c*, sagittal view of male copulatory apparatus. (Explanation on page 597.)

present species differs from it only in that the lateral orange stripes do not reach as far posteriorly, hence are not confluent behind the median stripe. This appears an insignificant difference. Stummer-Traunfels' specimen was part of the Semper material collected in the Philippines and the Palau Islands and not yet published; the colored figure was made from life by Mrs. Semper.

Nymphozoon, new genus

DEFINITION: Pseudoceridae with multiple female apparatuses, arranged in a midventral longitudinal row; sucker wanting; otherwise as in *Pseudoceros*.

TYPE SPECIES: *Nymphozoon bayeri*, new species.

Nymphozoon bayeri, new species

FIGURES 11*b*,*c*; 12*a*,*b*

MATERIAL: Two specimens were taken by the Stanford team, one on a reef flat at Iwayama Bay, Palau Islands, Sta. 133, Aug. 28, 1955; the other on shallow coral sand and eel grass in the same region, Sta. 85A, Oct. 29, 1955.

GENERAL CHARACTERS: This is a very large, handsome, black-and-white pseudocerid of delicate consistency. The larger specimen is 70 mm. long by 55 mm. wide, preserved, the smaller one 50 mm. by 30 mm. From the ruffling of the margins one may surmise that a considerably greater length may be attained in life. A photograph of the smaller specimen in life shows it to have been about 75 mm. long. The shape is broadly oval tapering to a somewhat pointed posterior end (fig. 12*a*); anteriorly there are present the usual tentacular folds. Figure 12*a* attempts to depict the striking color pattern. There is a narrow, very black, sharply delimited band along the margin that also edges the tentacular folds. Medially there is a moderately broad black longitudinal band that tapers to a point behind the tentacular folds and narrows posteriorly, but it could not be followed completely here because of damage. Between the median band and the margin there is present on each side a broad lateral band of grayish black hue that also could not be followed to the posterior end. The remainder of the animal is pure white. The large ruffled pharynx with central mouth is drawn in figure 12*b*. The smaller specimen is definitely devoid of any indication of the reproductive system but the larger specimen is fully mature. As shown in figure 12*b*, there is a pair of male pores behind the pharynx and this is succeeded by a midventral longitudinal row of eight pores, somewhat unevenly spaced. The nature of these pores could not be ascertained without sections and these showed that they are female gonopores. A sucker is definitely wanting. Bayer took a clear kodachrome of the smaller specimen in motion viewed from the ventral surface; the lack of a sucker is at once noticeable.

COPULATORY APPARATUS: It was unfortunately necessary to remove the anterior median part of the larger specimen for sectioning, as the nature of the row of midventral pores could not be determined otherwise. The sections showed the details of the male apparatuses and

FIGURE 12.—*Nymphozoon bayeri: a*, entire animal drawn from a photograph of the living specimen by Mrs. Patricia Isham; *b*, anterior central region cleared specimen, showing pharynx and gonopores. (Explanation on page 597.)

of the row of eight female apparatuses. The sagittal plane of the sections is not very favorable for the study of the male apparatus as this is oriented at an angle to that plane. However, one of them fell in part nearly in the plane of the sections and forms the basis for figure 11*c*. The expanded spermiducal vesicle, containing masses of sperm, enters the proximal end of an elongated seminal vesicle that is bent upon itself. Its proximal half has a thick muscular wall of

circular fibers. Distally the wall thins and the vesicle then makes a sharp bend, diminishing abruptly to a narrowed tube with thin muscular wall that parallels the thick muscular part. This tube then bends again and as a narrowed duct runs close to the oval prostatic vesicle, eventually coming in contact with the prostatic duct. The two ducts run in contact for some distance, then fuse to form an ejaculatory duct that passes to the surface. Seminal and prostatic vesicles are imbedded in a muscular area indicated by a dotted line in figure 11*c*. The ejaculatory duct could not be traced into the penis papilla, a nonmuscular conical elevation occupying a broad shallow male antrum and apparently devoid of the usual penis stylet characteristic of the Cotylea.

All eight female apparatuses are approximately identical and one of them is shown in sagittal view in figure 11*b*. The gonopore leads into a deep tubular female antrum having the same histological construction as the adjacent body wall. It is lined by an epithelium of tall narrow cells underlain by the usual muscle stratum. At its internal end the antrum enters the cement pouch of the vagina but the epithelium here appeared disrupted, whether normally or as a failure of fixation is not determinable. The cement pouch and the glandular tubular vagina leading inward from it receive a tremendous mass of cement glands on all sides. The vagina then expands and its wall, very thin in the glandular region, widens to a cuboidal epithelium of loose texture. The vagina then makes a bend, forward in some of the apparatuses, backward in others, and approaches a large cavity filled with eggs that appears to be a median uterus. Seemingly this species has a single median uterus in which the eggs collect rather than the usual paired uteri. All eight vaginas are directed towards this median uterus but none could be followed directly into it although some contained an egg or two. The uterus is bounded by a definite epithelial wall in which no openings could be found. However, one must suppose that, at the time of spawning, eggs are discharged from the uterus through all eight vaginas and out of all the gonopores. The absence of a sucker is presumably associated with the multiplication of female apparatuses that extend into the area where the sucker would normally occur.

Holotype: The larger specimen (USNM 28660) in alcohol is made the holotype, plus the removed anterior median part as sagittal serial sections (31 slides).

Remarks: The multiplication of male apparatuses is common in polyclads but the multiplication of female apparatuses is rare. Apart from anomalies the only comparable case of which I know is that of *Cestoplana polypora* Meyer (1921), in which also there is present a midventral longitudinal row of female apparatuses ranging in number

from 5 to 30 in different individuals. As only one sexual specimen of *Nymphozoon bayeri* is available it cannot be stated whether the number of female apparatuses shows individual variation. The lack of a sucker is unusual but not unique in Cotylea. A sucker is absent from *Amakusaplana ohshimai* Kato (1938a), and this author mentions two other cotyleans reported as devoid of a sucker; but it must be admitted that the sucker is very often difficult to see in preserved specimens.

The color pattern of the present species somewhat resembles that of *Pseudoceros gratus* Kato (1937), reported as common off the Palau Islands (Kato, 1943) but not recovered in the present material. Kato's species differs from *Nymphozoon bayeri* in that the margin has a mere black line rather than a band, in the much narrower lateral black stripes, and in attaining sexual maturity at a length of 50 mm. Kato makes no statement about the sucker but declares there is a pair of male copulatory apparatuses. The female apparatus is not mentioned. As already indicated, it appears to me that *Pseudoceros gratus* is identical with *Eurylepta striata* Schmarda (1859) rather than, as supposed by Kato, with "*Stylochoplana*" *meleagrina* Kelaart (1858), in which the stripes are purplish and the tentacles are "occipital," meaning, no doubt, nuchal.

Genus *Acanthozoon* Collingwood, 1876

Definition: Pseudoceridae with dorsal surface covered with small papillae or tubercles; otherwise as in *Thysanozoon*.

Type species: *Acanthozoon armatus* (Kelaart) (1858).

Acanthozoon nigropapillosus, new species

Figure 13

Material: One specimen found swimming off the reef edge at Falarik Islet, Ifaluk Atoll, Sta. 616, collected by Migel, a native of Sonsorol, Oct. 18, 1953, under the auspices of the Pacific Science Board Atoll Research Program.

General characters: The worm is of broadly oval shape (fig. 13), measuring 15 by 14 mm., preserved. It is black with a pale yellowish border, present in only a few places as the margin is damaged. The dorsal surface is covered with low rounded black papillae tipped with white, hence to the naked eye the dorsal surface appears black dotted with white. This appearance is depicted in a small area on figure 13. At the middle of the anterior end the tentacular folds are evident but eyes could not be seen because of the black color. Behind the tentacles an oval area houses the ruffled pharynx of which only a few folds were detectable. The mouth opening, posterior to the pharynx middle,

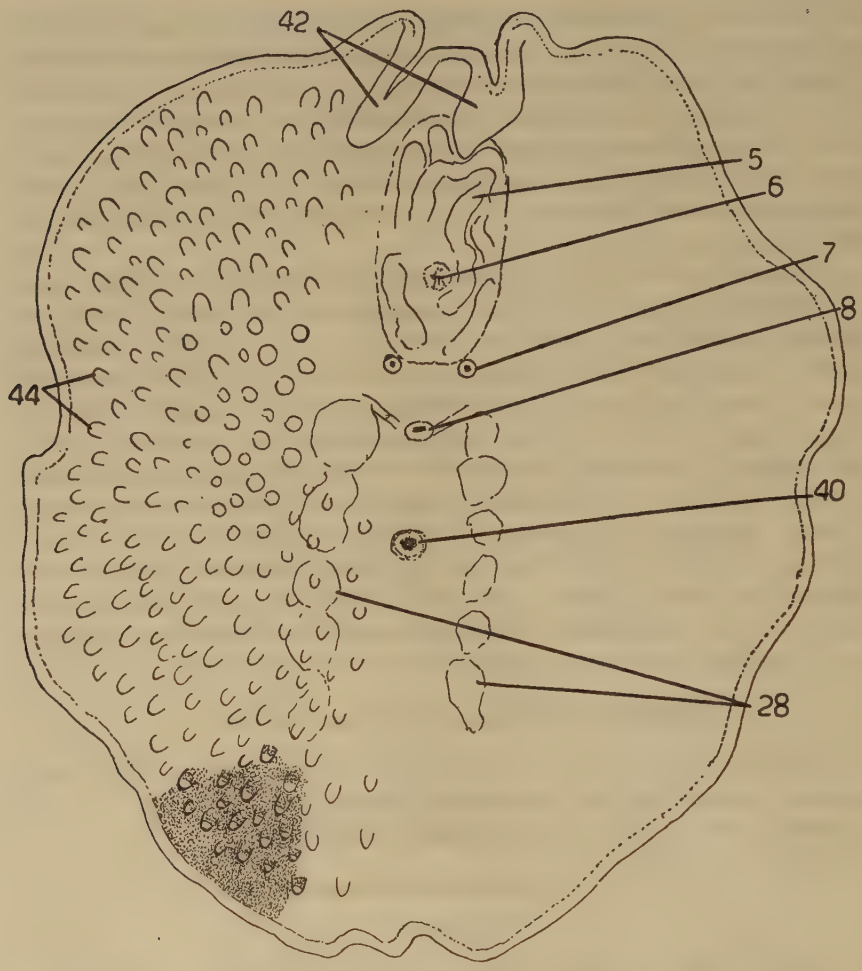

FIGURE 13.—*Acanthozoon nigropapillosus*, entire worm. (Explanation on page 597.)

is evident. Behind the pharynx are plainly seen the two male pores on hillocks, followed by the median female pore. The sucker, larger than the hillocks around the gonopores, is conspicuous, located slightly posterior to the middle. The convolutions of the uteri are seen to either side in the postpharyngeal region.

DIFFERENTIAL DIAGNOSIS: The black color with black white-tipped papillae is distinctive.

HOLOTYPE: USNM 28661, in alcohol.

REMARKS: Marcus (1950) recommended revival of *Acanthozoon* for pseudocerids with low dorsal elevations. Eveline Marcus (1955) reduced *Acanthozoon* to a subgenus of *Pseudoceros*. However, if *Pseudoceros* be defined as Pseudoceridae with a smooth dorsal surface

(Hyman, 1953a), *Acanthozoon* cannot become a subgenus of *Pseudoceros* but would more logically be made a subgenus of *Thysanozoon*, which would then include all pseudocerids with dorsal elevations. In fact, one may anticipate that difficulty must eventually arise in determining when the elevations are low enough to fit into *Acanthozoon* and when tall enough to fit into *Thysanozoon*. This dilemma has not yet arisen. Eveline Marcus (1955) has listed the species to be transferred to *Acanthozoon* and this information therefore need not be given here. I favor retaining the genus *Acanthozoon* for the species listed by Marcus.

Acanthozoon albopapillosus, new species

FIGURE 14*a*,*b*

MATERIAL: One damaged specimen collected July 22, 1954, in the Palau Islands. No other data available.

GENERAL CHARACTERS: The specimen is nearly circular but the posterior part is missing, hence the shape of the intact worm was probably oval. The sides are also damaged. The tentacular folds are poorly preserved. A pair of eye clusters can be seen in the tentacular region and behind them is a single oval cluster of cerebral eyes. The ruffled pharynx is large and voluminous, so much so that damage and rupture are suggested. Behind the pharynx is seen the sucker whose pointed shape is probably unnatural. There are no indications of any part of the reproductive system, hence this must be a large worm when intact and mature. Because of extensive damage the dimensions of the specimen are of little value. In the longitudinal axis it measures 26 mm., in width 25 mm. anteriorly, 35 mm. posteriorly. Despite damage the specimen is worth naming because of the distinctive color pattern. It is black with flesh-colored marginal band and rounded pinkish buff areas all over the dorsal surface. These areas are in general smaller towards the periphery. The pattern is indicated on the right side of figure 14*a*. The entire dorsal surface is thickly strewn with small rounded white papillae, hence this surface appears dotted with white to the naked eye. These papillae are indicated in the upper left of figure 14*a*. The ventral surface is pale except for a wide black band subtending the pale margin. This black band is shown on an upturned fold in the lower left of figure 14*a*. It is quite conspicuous when the worm is viewed from the ventral side.

PAPILLAE: A small bit of the worm was removed and sectioned to see the structure of the papillae. The histology of the papillae of *Acanthozoon* was given by Kato (1934) for *A. micropapillosus* and by Eveline Marcus (1955) for *A. hispidus*. Both find that the papillae are elevations of the mesenchyme covered with a cuboidal epithelium

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FIGURE 14.—*Acanthozoon albopapillosus: a*, entire worm; *b*, section through one of the papillae. (Explanation on page 597.)

containing eosinophilous granules. In the present species the papilla is covered with an epithelium much taller than that of the adjacent body wall (fig. 14*b*). Rhabdites are present only basally and the muscle layer is much reduced in the papilla. Distally the epithelium contains large eosinophilous droplets. Hence it appears that the papillae are secretory, probably productive of adhesive material.

DIFFERENITAL DIAGNOSIS: *A. albopapillosus* differs from other species of *Acanthozoon* in the distinctive color pattern of pinkish buff areas on a black ground, pale marginal band subtended ventrally by a black band, and numerous white papillae over the dorsal surface.

HOLOTYPE: The specimen, in alcohol, is deposited in the American Museum of Natural History.

Family Eurylептidae

Acerotisa rugosa, new species

FIGURES 15*a–c*; 16*a*

MATERIAL: Six specimens were taken by the Stanford team in the Palau Islands at Stations 28, 69, 92 (two lots), 220A, and 236 during July, August, and October 1955.

GENERAL CHARACTERS: The form is oval (fig. 15). Three of the specimens (from Stations 69, 92, and 236) were extremely small, less than a millimeter in length. These are devoid of any signs of reproductive organs and have an eye pattern typical of juvenile *Acerotisa*. The specimen from Sta. 92 is shown in figure 15*a*. It is 0.9 mm. long, has one large and one small eye in each marginal group, and four eyes in each cerebral group, of which three form a row immediately in front of the pharynx. An identical eye pattern occurs in the specimen (also 0.9 mm. long) from Sta. 69 except that each marginal group includes an additional small eye. The smallest specimen, from Sta. 236, measures 0.6 mm. in length and also has four cerebral eyes on each side, but the group of three is in front of the single eye; there are four marginal eyes on each side. The three remaining specimens are all of larger size and show increase in eye number and varying degrees of sexual maturity. The specimen from Sta. 28 is shown in figure 15*b*. It is 1.4 mm. long and has seven to eight cerebral eyes on each side and five eyes in each marginal group. The female gonopore and the male copulatory apparatus are evident in this specimen; the latter is seen under the posterior half of the pharynx in the figure. Another worm of about the same size, 1.5 mm. long, from Sta. 220A, has eight cerebral eyes on one side, 10 on the other, and a total of about 30 marginal eyes, distorted out of their normal positions. Finally, the largest specimen, from Sta. 92, measures 5 by 3.5 mm. It is fully mature and presumably represents the maximum size of the species. Its cerebral clusters contain 9 eyes on one side and 11 on the other, and there are about 17 eyes in each marginal group (fig. 15*c*).

All specimens have a rugose dorsal surface caused by bundles of rhabdites which tend to form little pointed projections, as shown in the small turned back fold on the upper left of figure 15*c*. There are also evident in the largest specimen flask-shaped glands along the periphery, although these are not as regularly and closely arranged as in *Acerotisa multicelis* Hyman (1955a).

The small specimens appear colorless or pale but the largest one is reddish brown. The position of the sucker is shown in the figures; it was much distended in the specimen depicted in figure 15*b*. The

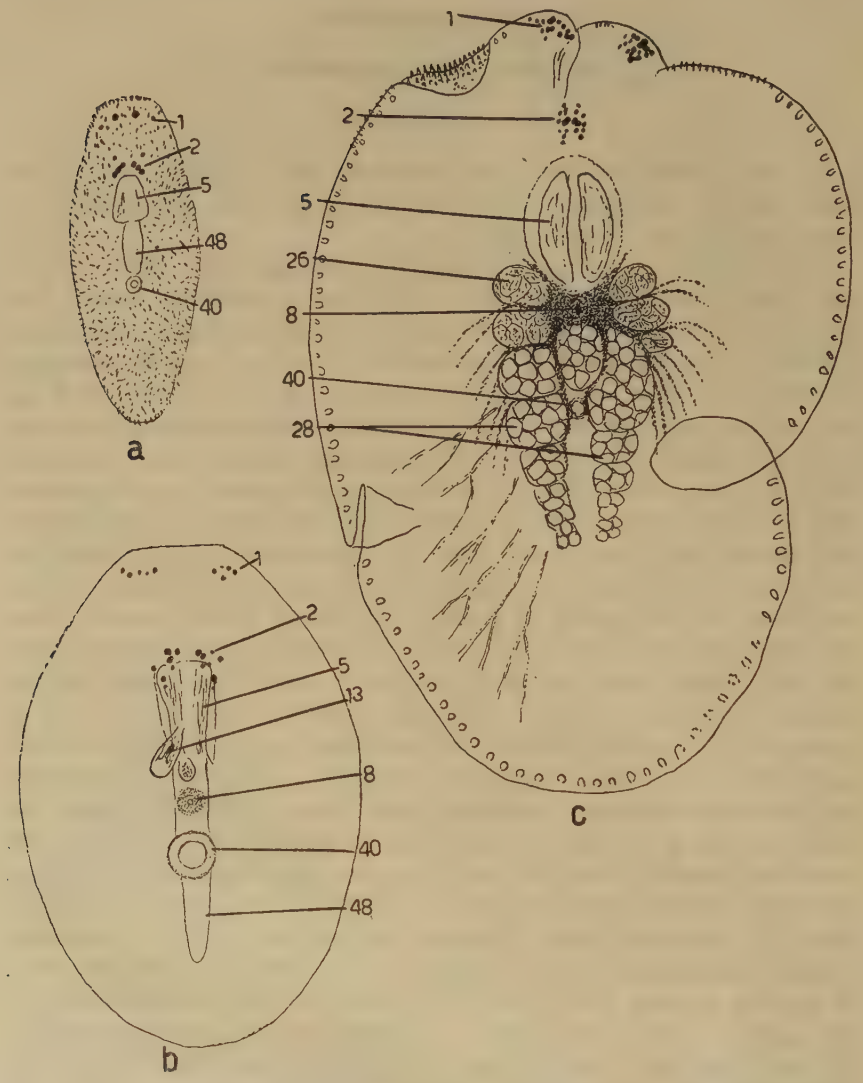

FIGURE 15.—*Acerotisa rugosa: a*, very small specimen; *b*, specimen of medium size; *c*, mature worm. (Explanation on page 597.)

branches of the intestine, of which a few are shown in the lower left of figure 15*c*, do not anastomose, at least not to any extent.

REPRODUCTIVE SYSTEM: As there is only one fully mature specimen, I have forborne to section it. However, most of the details of the reproductive system could be ascertained in the cleared, mounted worm. The female gonopore, encircled by radiating cement glands, is located just behind the root of the pharynx (fig. 15*c*). To each side of it are seen the coils of the spermiducal vesicles. Extending back-

wards from it on each side occur the coils of the two uteri, filled with large eggs. The male copulatory apparatus underlies the left side of the pharynx and the male gonopore lies at the anterior margin of the pharyngeal cavity (fig. 16*a*). At the posterior end of this cavity coils of the spermiducal vesicles can be seen approaching the proximal end of the long fusiform seminal vesicle which is nearly as long as the pharynx in the specimen, underlying the left side of this organ. The seminal vesicle is provided with a coat of circular muscle fibers and is filled with a dense mass of sperm. At its distal end the seminal vesicle narrows to a duct that underlies the oval prostatic vesicle, in which the radiations of the glandular interior are clearly visible. At the distal end of the prostatic vesicle is seen the short penis stylet with truncate tip. Other details are not discernible in the whole specimen. The fact that the male apparatus lies under the posterior half of the pharynx in the medium sized specimen (fig. 15*b*) is rather puzzling and seems to indicate a forward migration of this apparatus with sexual maturity.

Differential diagnosis: *Acerotisa rugosa* is distinguished by the rugose dorsal surface, anterior position of the male gonopore, and short truncate penis stylet. Of other species with a similar anterior position of the male gonopore, *A. inconspicua* (Lang) (1884) has very few eyes, *A. meridiana* (Ritter-Zahony) (1907) has the intestinal branches anastomosed to a network, and *A. californica* Hyman (1953a) has a long pointed penis stylet.

Holotype: USNM 28662, whole mount. The other five specimens (USNM 28663–USNM 28667) are also whole mounts.

Remarks: Marcus (1947) listed and gave characters of the seven valid species of *Acerotisa* known at that time. In the same article he described three new species of *Acerotisa: piscatoria, leuca,* and *bituna.* Since then there have been named: *A. arctica* Hyman (1953a), *californica* Hyman (1953a), and *multicelis* Hyman (1955a). Mention should also be made of *Oligocladus albus* Freeman (1933), which probably belongs to *Acerotisa,* but the one specimen is so imperfectly known that decision is impossible at present.

Family Prosthiostomidae

***Prosthiostomum exiguum,* new species**

Figures 16*b,c;* 17*a*

Material: Two specimens were taken by D. Reish on Eniwetok Atoll, on coral rock on the inner reef flat, Sta. E–8, Aug. 21, 1956. A third specimen, taken in the same locality and type of habitat at Sta. E–2, was so distorted and broken that it was discarded as useless.

General characters: This is a very small species, with the two

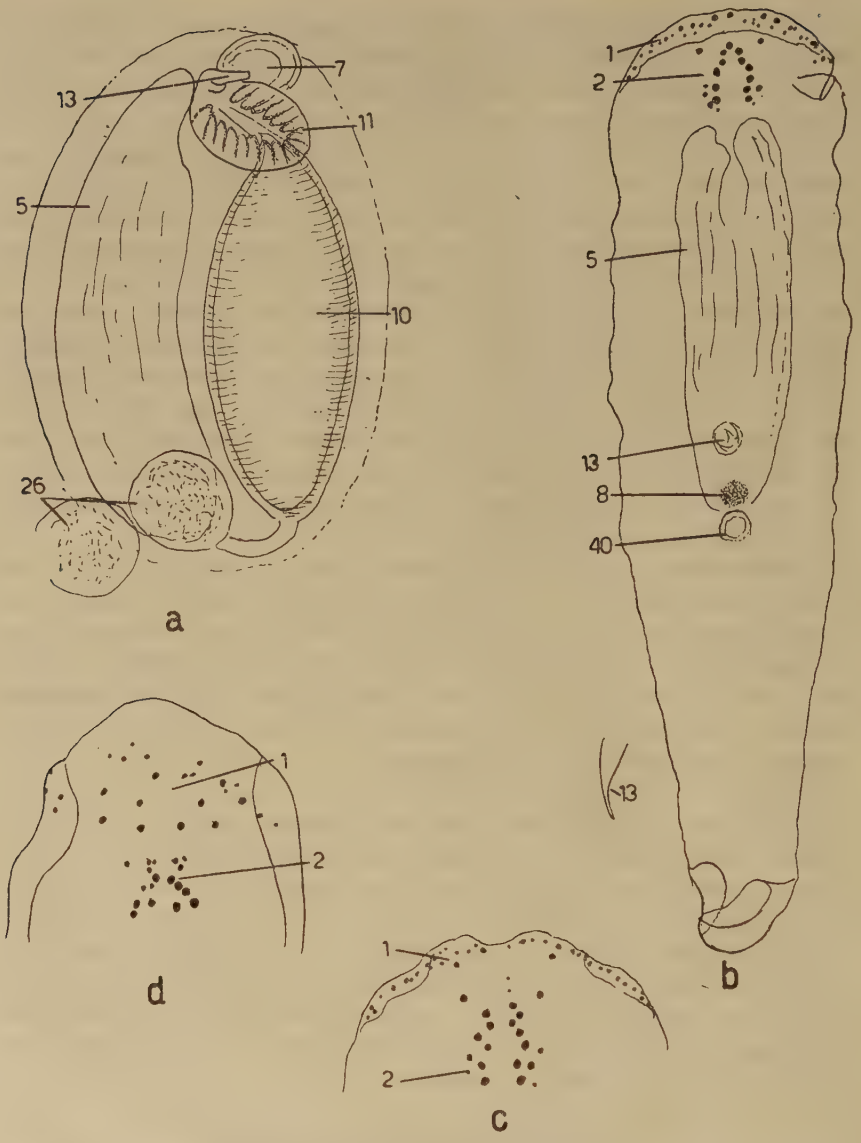

FIGURE 16.—*a*, *Acerotisa rugosa*, copulatory apparatus as seen from above in whole mount. *b*, *c*, *Prosthiostomum exiguum*: *b*, entire animal; *c*, eyes enlarged; *d*, *P. griseum*, anterior end enlarged. (Explanation on page 597.)

specimens measuring 4 mm. and 5 mm. in length (fig. 16*b*). The species is of the usual slender shape, broader anteriorly with rounded anterior margin, tapering behind the pharynx to a blunt posterior end. The color appeared to be a dirty white. The eye arrangement is shown in figure 16*b*, and enlarged in 16*c*. Along the anterior margin is a

band of small eyes, not definitely divided at the middle, numbering about 35 in the 4-mm. specimen (fig. 16*b*), about 40 in the 5-mm. specimen (fig. 16*c*). The cerebral eyes are large and relatively few in number, ranging from 8 to 12 on each side, in the two specimens. A marked feature of the eye pattern is the presence of a single isolated eye on each side at the level of the anterior end of the cerebral groups. Such a pair of eyes set apart from the cerebral groups is known in a number of species of *Prosthiostomum* and therefore is not diagnostic. Some authors speak of this pair of eyes as ventral but in my material the pair appears on the same level as the other cerebral eyes. The large tubular pharynx, often partly protruded or discarded on fixation, has remained in situ in the smaller specimen but was missing from the larger one There appeared to be no median intestinal branch above the pharynx. Beneath the posterior end of the pharynx is seen the terminal part of the male apparatus, at the attached end of the pharynx is located the female gonopore, and shortly behind the latter occurs the sucker.

Copulatory apparatus: Both specimens are sexually mature. The larger specimen was sectioned sagittally, and a sagittal view of the copulatory structures is shown in figure 17*a*. The male and female gonopores and the sucker lie close together but the distance between the two gonopores is slightly greater than the distance between the female gonopore and the sucker. The male gonopore leads into a long tubular antrum, slanted forward so as to lie almost parallel to the ventral body wall. At the anterior end of the male antrum is seen the penis, an oval body containing the usual penis stylet, whose tip is protected by the penis sheath projecting into the antrum as a slight elevation. Details of the penis were not very clear in the sections; the usual eosinophilous granulation, indicative of prostatic secretion, appeared present in the wall around the stylet. The proximal end of the penis receives the ejaculatory duct and the ducts of the two accessory vesicles. The latter are the usual round muscular bodies with small lumen and thick wall of circular fibers. They occur one behind the other. The more posterior one lies just behind the level of the proximal end of the seminal vesicle; the other is located on the other side of the seminal vesicle at a level just below the posterior end of the latter. The seminal vesicle is retort-shaped, curved on itself; its proximal end is rounded with a thick wall of muscle fibers paralleling its contours; distally, as the vesicle curves posteriorly parallel to itself, the muscular wall thins. The entrance of the sperm ducts into the seminal vesicle could not be followed. The spermiducal vesicles swollen with sperm are obvious alongside the seminal vesicle. They have been omitted from figure 17*a* to avoid complicating it. One occurs above the seminal vesicle and the other below, but the usual

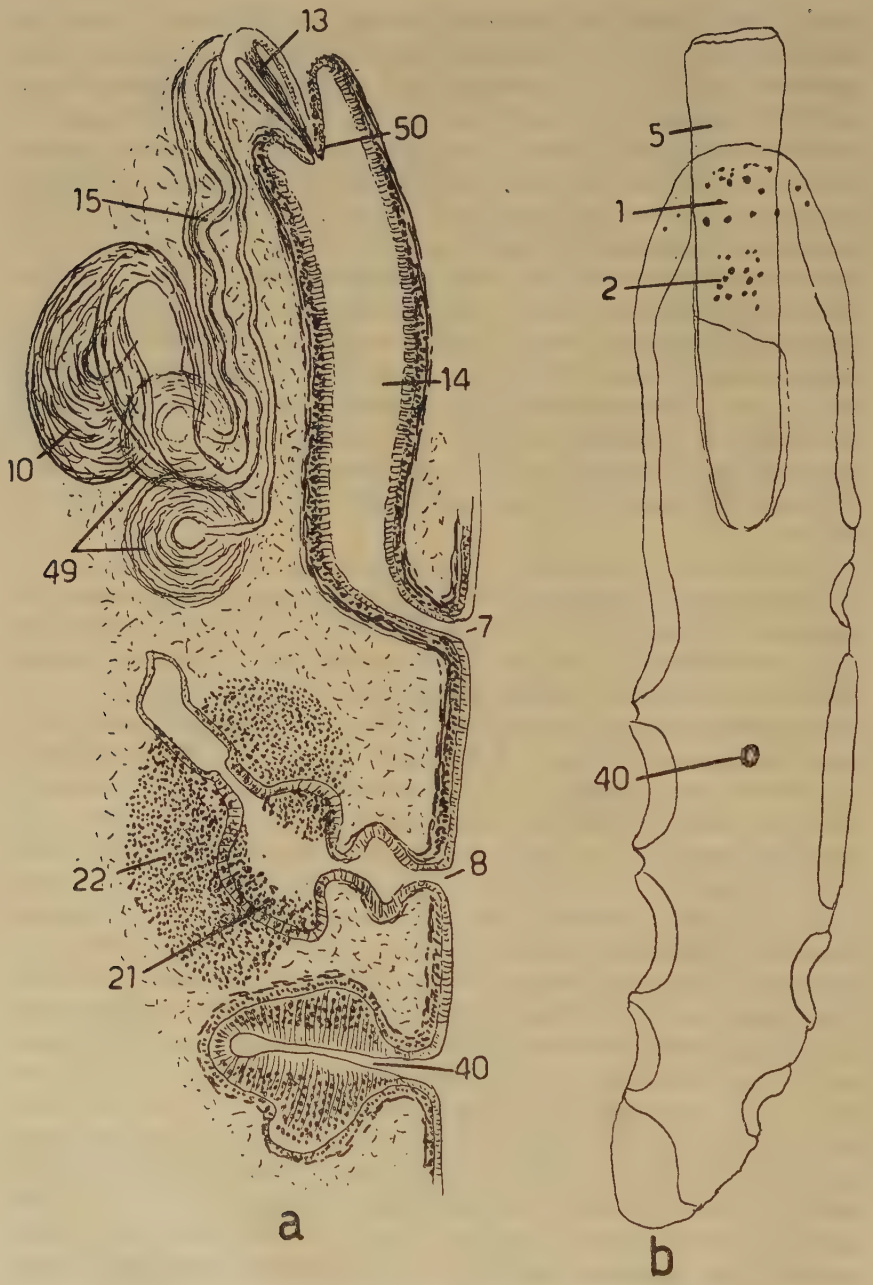

FIGURE 17.—*a, Prosthiostomum exiguum*, sagittal view of copulatory complex, male system above. *b, P. griseum*, entire worm. (Explanation on page 597.)

sperm ducts from the spermiducal vesicles into the seminal vesicle could not be found. The ejaculatory duct issues ventrally from the thinned distal end of the seminal vesicle, turns forward, and pursues a sinuous course to the proximal end of the penis, accompanied above by the duct of the more anterior accessory vesicle, below by the duct of the more posterior one. The penis stylet as seen in the whole specimen before sectioning is shown to the left of the posterior part of figure 16*b*. The male antrum is lined by an epithelium of tall, narrow cells, outside of which occur considerable layers of circular and longitudinal muscles. These layers continue along the ventral body wall to the female pore.

The female gonopore leads by a short tubular female antrum into a vaginal chamber lined by an epithelium of tall, narrow cells, with very little muscular investment. This again leads by a short narrow passage into a larger chamber, the glandular vagina, or cement pouch. The cement pouch is lined by an epithelium of less narrowed cells, penetrated by the outlets of the cement glands. The latter surround the cement pouch as a mass of eosinophilous granules in which cells are not detectable. The cement pouch lacks musculature. From its anterodorsal side the vagina continues as a tube that receives the uteri about on a level with the posterior accessory vesicle of the male system.

Behind the female apparatus is seen the sucker, forming a rather large deep pouch lined by an epithelium of exceedingly long narrow cells underlain by a muscular investment about equal to that of the ventral body wall with which it is continuous.

Differential diagnosis: Marcus (1949, 1950, 1952) listed the described species of *Prosthiostomum,* with authors and references, and in the 1952 article added one new species, making a total of 53 members of the genus. Since then there have been described *P. latocelis* Hyman (1953a) and *P. multicelis* Hyman (1955a). As the members of the genus are all very much alike, specific identification poses a difficult problem. The main characters are the eye pattern and number and details of the copulatory apparatuses. A few species have a distinctive color pattern but most are white or pale. To determine the status of the present specimens, all the original descriptions were inspected (except those of Stimpson, 1857, probably unrecognizable) but none could be found agreeing with their characters. In its small size at sexual maturity *P. exiguum* differs from most of the described species. A pair of eyes set off from the cerebral clusters occurs in *P. siphunculus, P. monosora, P. drygalskii, P. parvicelis, P. sonorum, P. vulgare, P. delicatum, P. notoensis,* and *P. nozakensis,* but other details of eye pattern and number differ from those of *P. exiguum* except in *P. drygalskii* and *P. vulgare.* In these two species

eye number and arrangement are identical with those of *P. exiguum* and, in fact, for some time it was thought the present specimens might be *P. vulgare* Kato (1938b), but the details of the copulatory apparatus are irreconcilable between the two. *P. exiguum* is then distinguished by the following combination of characters: small size at sexual maturity, uniform pale coloration, eye pattern (fig. 16*b,c*), long cylindrical male antrum almost horizontally oriented, retort-shaped seminal vesicle, issuance of ejaculatory duct posteriorly and ventrally, and female apparatus of two successive chambers.

HOLOTYPE: USNM 28668, the larger specimen as whole mount. The smaller specimen (USNM 28687) is deposited as sagittal serial sections (one slide).

***Prosthiostomum griseum*, new species**

FIGURES 16*d*; 17*b*

MATERIAL: One specimen collected by D. Reish at Parry Island, Eniwetok Atoll, on the lagoon side in September 1956.

GENERAL CHARACTERS: This is a very small worm, 4 mm. long, of the slender shape characteristic of the genus (fig. 17*b*). It is of a uniform dark gray coloration. The eye pattern (fig. 16*d*) is very unusual in the genus. The marginal eyes, relatively few in number and rather large, are not arranged in the usual marginal band but are scattered over the anterior end between the cerebral eyes and the anterior margin. The cerebral eyes occur in the usual two groups of 8–10 eyes each. The tubular pharynx is partly protruded. The sucker occurs unusually far posterior to the pharynx, about 0.8 mm. behind the root of the latter. The specimen is juvenile with only the beginnings of gonads and no indication of copulatory apparatuses. It has such distinctive characters, however, that giving it a specific name appears justified.

DIFFERENTIAL DIAGNOSIS: The scattering of the marginal eyes over the anterior end is seen in only one other of the 56 described species of *Prosthiostomum;* namely, in *P. latocelis* Hyman (1953a). The latter, however, is pale, with numerous cerebral eyes, and with the sucker close to the root of the pharynx. The present species is readily distinguished by the gray color, scattering of the marginal eyes over the anterior end, and posterior position of the sucker.

HOLOTYPE: USNM 28669, a whole mount.

REMARKS: Kato (1938a) created the genus *Amakusaplana* for a prosthostomid identical with *Prosthiostomum* except that all eyes are scattered over the anterior end and a sucker appears wanting. The species *Prosthiostomum latocelis* and *P. griseum* constitute forms intermediate between typical *Prosthiostomum* and *Amakusaplana* in that their marginal eyes are scattered but their cerebral eyes remain in

definite clusters. The intermediate character of these two species gives grounds for doubt that *Amakusaplana* can be maintained as a distinct genus.

Collecting Stations

Following is a list of stations at which polyclads were collected in the Palau Islands by a team composed of R. R. Harry and H. A. Fehlmann of Stanford University and F. M. Bayer of the U. S. National Museum. Geographical coordinates of each locality based upon Hydgrographic Office charts are noted in parentheses. Numbers of traverses and islands in Iwayama Bay follow the work of Abe (1937) and of Abe, Eguchi, and Hiro (1937).

Sta. 28. July 21, 1955. Outer reef at eastern end of Urukthapel Island, about 1½ miles north of Pkulasuch Point: 7°16′13″ N., 134°27′35″ E. (H. O. 6103, 1st. ed., 1944). Depth 2–4 ft., in breakers; bottom covered with *Turbinaria* (*Acerotisa rugosa*, n. sp.; Leptoplanidae, juv.)

Sta. 30. July 22, 1955. Iwayama Bay, between south shore of Kaibakku (Island xxix) and Kogai-hantô, Auluptagel Island (traverse xi): 7°19′12″ N., 134°29′37″ E. (H. O. 6076, 2d ed., 1944). Depth 0–3 ft.; sand, coral, with vegetation consisting mainly of *Enhalus* and *Caulerpa*. (*Asolenia deilogyna*, n. sp.)

Sta. 37. July 25, 1955. Middle of channel between Peleliu and Ngedebus Islands: 7°2′57″ N., 134°16′20″ E. (H. O. field chart 4007). Depth 4–8 feet; bottom sand with massive coral heads and vegetation of *Enhalus acoroides*. (*Pseudoceros fuscogriseus*, n. sp.)

Sta. 47. July 28, 1955. Iwayama Bay, in cove formed by west arm of Kogai-hantô, around Islands xxxiii and xxxiv: 7°18′58″ N., 134°29′32″ E. (H. O. 6076, 2d. ed., 1944). Depth, 0–10 ft.; bottom sand with living and dead coral with *Enhalus* growing in sand and *Padina* on rocky areas. (Leptoplanidae, juv., from sponge washings.)

Sta. 60. Aug. 5, 1955. North shore of Koror Island, west of Ebadul's Pier: 7°20′48″ N., 134°28′12″ E. (H. O. 6076, 2d. ed., 1944). Sand flat; occasional coral heads, with *Enhalus* growing on sandy areas, *Sargassum* attached to rocks. (Leptoplanidae, juv.)

Sta. 64. Aug. 7, 1955. Small bay at southern end of Meherehar (the lagoon of Eil Malk): 7°9′23″ N., 134°21′48″ E. (H. O. 6078, 1st ed.). Depth 6–20 ft.; bottom limestone, little sand and scant coral; among sponges, hydroids, and tunicates. (*Latocestus pacificus* Laidlaw.)

Sta. 69. Aug. 8, 1955. Lagoon margin of reef extending north between east end of Urukthapel Island and Malakal Pass: 7°16′10″ N., 134°27′26″ E. (H. O. 6103, 1st ed., 1944). Depth 3–4 ft.; living and dead coral, rubble; pot holes with sand. (*Pseudoceros izuensis* Kato; *Acerotisa rugosa*, n. sp.)

Sta. 77. Aug. 10, 1955. Bay in southernmost coast of Auluptagel Island; in mouth of bay and narrow pass at its middle: 7°17′52″ N., 134°29′20″ E. (H. O. 6105, 1st ed.). Depth 1–12 ft.; bottomsand, some coral rubble and limestone; vegetation of eel-grass, *Caulerpa*, and *Halimeda*. (*Pseudoceros caeruleocinctus*, n. sp.)

Sta. 85. Aug. 12, 1955. Iwayama Bay, between south shore of Kaibakku (Island xxix) and Kogai-hantô, Auluptagel Island: 7°19′12″ N., 134°29′37″ E. (H. O. 6076, 2d ed., 1944). (Approximately the same locality as Sta. 30 but a few feet west.) Depth 5–6 ft.; sand and coral, with vegetation of *Enhalus*, *Caulerpa*, and *Halimeda*. (*Pseudoceros fulvogriseus*, n. sp.)

Sta. 92. Aug. 14, 1955. Iwayama Bay; south end of Gua-zima (Island xv): 7°20′00″ N., 134°29′37″ E. (H. O. 6076, 2d ed.). Depth 0–20 ft.; sandy flat and fringing reef, with vegetation of *Enhalus*, *Halimeda*, *Padina*. (*Acerotisa rugosa*, n. sp.)

Sta. 133. Aug. 28, 1955. Iwayama Bay: south shore of Island ii (traverses viii, ix, x), 7°19′20″ N., 134°29′15″ E. (H. O. 6076, 2d ed.). Reef flat covered with 2–3 feet of water at mean low tide, with pool about 15 ft. deep; bottom coral and sand, with *Enhalus*, *Halimeda*, and *Padina*. (*Nymphozoon bayeri* n. sp.)

Sta. 220. Oct. 12, 1955. Iwayama Bay: east side of Oyster Pass (Kaki-suidô) between Island xxix and east end of Koror. 7°18′57″ N., 134°30′09″ E. (H. O. 6076, 2d ed.). Bottom limestone, with living and dead coral, depth, 3–20 ft. (*Aquaplana pacifica*, n. sp.; Leptoplanidae, juv.)

Sta. 220A. Oct. 22, 1955. Locality as for Sta. 220. (*Acerotisa rugosa*, n. sp.)

Sta. 236. Oct. 18, 1955. Iwayama Bay, somewhat north of position of Sta. 220: 7°19′00″ N., 134°30′11″ E. (H. O. 6076, 2d. ed.). Limestone shelf with living and dead coral, depth 3–20 ft. (*Acerotisa rugosa*, n. sp.)

Sta. 236A. Oct. 20, 1955. Locality as for Sta. 236. (*Pseudoceros ferrugineus*, n. sp.)

Sta. 254. Oct. 27, 1955. Outer reef (called Raeldil) south of Ngaremediu, east cape of Urukthapel Island: 7°14′37″ N., 134°27′11″ E. (H. O. 6078, 1st ed.). Reef flat with sand patches among living and dead coral, depth 2½ to 3½ ft. (awash at spring tides); collected by the light of gasoline lanterns, just before midnight. (*Plehnia tropica*, n. sp.; *Pseudoceros ater*, n. sp.).

Sta. 258. Nov. 2, 1955. East side of Urukthapel Island, in small bay north of Ngaremediu Peak, at end of trail leading to Palau Lighthouse (not functional): 7°15′57″ N., 134°26′55″ E. (H. O. 6103 xx ed.). Bottom sand and limestone, with living and dead coral; *Enhalus* and *Halimeda*. (*Leptoplanidae*, juv.).

References

Abe, Noboru

1937. Ecological survey of Iwayama Bay, Palao. Palao Trop. Biol. Stat. Stud., vol. 1, No. 2, pp. 217–324, 42 figs.

Abe, Noboru; Eguchi, M.; and Hiro, F.

1937. Preliminary survey of the coral reef of Iwayama Bay, Palao. Palao Trop. Biol. Stat. Stud., vol. 1, No. 1, pp. 17–35, 1 text fig., 2 pls., chart.

Blanchard, Émile

1847. Recherches sur l'organisation des vers. Ann. Sci. Nat., Zool., vol. 8, pp. 271–275, 2 pls.

Bock, Sixten

1913. Studien über Polycladen. Zool. Bidr., vol. 2, pp. 31–344, 67 figs., 8 pls.

COLLINGWOOD, C.
1876. On 31 species of marine planarians, collected partly by the late Dr. Kelaart, F. L. S., and partly by Dr. Collingwood, F. L. S., in the eastern seas. Trans. Linnaean Soc. London, ser. 2, zool., vol. 1, pp. 83–98, 3 col. pls.

FREEMAN, DANIEL
1933. The polyclads of the San Juan region of Puget Sound. Trans. Amer. Microsc. Soc., vol. 52, pp. 107–146, 40 figs.

HYMAN, LIBBIE HENRIETTA
1953a. The polyclad flatworms of the Pacific coast of North America. Bull. Amer. Mus. Nat. Hist., vol. 100, pp. 265–392, 161 figs.
1953b. Some polyclad flatworms from the Galápagos Islands. Allan Hancock Pacific Expeditions, vol. 15, pp. 183–210, 6 pls.
1954. The polyclad genus *Pseudoceros*, with special reference to the Indo-Pacific region. Pacific Sci., vol. 8, pp. 219–225, 2 figs.
1955a. Some polyclad flatworms from the West Indies and Florida. Proc. U. S. Nat. Mus., vol. 104, pp. 115–150, 9 figs.
1955b. Some polyclad flatworms from Polynesia and Micronesia. Proc. U. S. Nat. Mus., vol. 105, pp. 65–82, 5 figs.
1955c. A further study of the polyclad flatworms of the West Indian region. Bull. Mar. Sci. Gulf Caribbean, vol. 5, pp. 259–268, 8 figs.

KATO, KOJIRO
1934. Polyclad turbellarians from the neighborhood of the Mitsui Institute of Marine Biology. Japanese Journ. Zool., vol. 6, pp. 123–138, 14 figs., 1 pl.
1936. Notes on *Paraplanocera*. Japanese Journ. Zool., vol. 7, pp. 21–29, 5 figs.
1937. Polyclads collected in Idu, Japan. Japanese Journ. Zool., vol. 7, pp. 211–232, 24 figs., 2 pls.
1938a. Polyclads from Amakusa, southern Japan. Japanese Journ. Zool., vol. 7, pp. 559–576, 26 figs., 2 pls.
1938b. Polyclads from Seto, middle Japan. Japanese Journ. Zool., vol. 7. pp. 577–593, 20 figs., 2 pls.
1943. Polyclads from Palao. Bull. Biogeogr. Soc. Japan, vol. 13, pp. 79–90, 14 figs., 1 pl.
1944. Polycladida of Japan. Journ. Sigenkagaku Kenkyuso, vol. 1, pp. 257–318, 62 figs., 4 pls.

KELAART, E. F.
1858. Description of new and little known species of Ceylon nudibranchiate mollusks and zoophytes. Journ. Ceylon Branch Roy. Asiatic Soc., for 1856–1858, pp. 134–139, 1 fig.

LAIDLAW, FRANK FORTESCUE
1902. The marine Turbellaria with an account of the anatomy of some of the species. *In* Gardiner, The fauna and geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, pp. 282–311, 16 figs., 2 pls.
1903a. Notes on some marine Turbellaria from Torres Straits and the Pacific, with a description of new species. Mem. Proc. Manchester Lit. Philos. Soc., vol. 47, No. 5, 12 pp.
1903b. On a collection of Turbellaria Polycladida from the Straits of Malacca (Skeat Expedition). Proc. Zool. Soc. London, pp. 301–318, 5 figs., 1 pl.

LANG, ARNOLD
1884. Die Polycladen (Seeplanarien) des Golfes von Neapel und der angrenzenden Meeresabschnitte. Fauna und Flora des Golfes von Neapel. Monogr. XI, 688 pp., 54 figs., 39 pls.

MARCUS, ERNESTO
1947. Turbelarios marinhos do Brasil. Zoologia (São Paulo, Brazil), No. 12, pp. 99–214, 21 pls.
1949. Turbellaria brasileiros (7). Zoologia (São Paulo, Brazil), No. 14, pp. 7–155, 22 pls.
1950. Turbellaria brasileiros (8). Zoologia (São Paulo, Brazil), No. 15, pp. 5–191, 34 pls.
1952. Turbellaria brasileiros (10). Zoologia (São Paulo, Brazil), No. 17, pp. 5–187, 32 pls.
1954. Turbellaria brasileiros. XI. Pap. Avuls. Dep. Zool. Secr. Agr., São Paulo, Brazil, vol. 11, pp. 419–489, 71 figs.

MARCUS, EVELINE DU BOIS-REYMOND
1955. On Turbellaria and *Polygordius* from the Brazilian coast. Zoologia (São Paulo, Brazil), No. 20, pp. 19–53, 6 pls.

MEYER, FRIEDA
1921. Polycladen von Kosier (Rotes Meer). Arch. Naturg., vol. 87, Abt. A, Fasc. 10, pp. 138–158, 8 figs., 3 pls.

PLEHN, MARIANNE
1896. Neue Polycladen gasammelt von Herrn Kapitän Chierchia bei der Erdumschiffung der Korvette Vettor Pisani. Jenaische Zeitschr. Naturw., vol. 30, pp. 137–176, 6 pls.
1897. Drei neue Polycladen. Jenaische Zeitschr. Naturw., vol. 31, pp. 90–99.

PRUDHOE, STEPHEN
1945. On the species of the polyclad genus *Paraplanocera*. Ann. Mag. Nat. Hist., ser. 11, vol. 12, pp. 195–202, 2 figs.

RITTER-ZAHONY, RUDOLPH VON
1907. Turbellarien: Polycladiden. Ergebnisse Hamburger Magalhaenischen Sammelreise, 1892–1893, vol. 3, 19 pp., 9 figs., 1 pl.

SCHMARDA, LUDWIG K.
1859. Neue wirbellose Thiere beobachtet und gesammelt auf einer Reise um die Erde, 1853 bis 1857 . . . Band I: Turbellarien, Rotatorien und Anneliden, Hälfte I, pp. 1–37, 8 pls.

STIMPSON, W.
1855. Descriptions of some new marine Invertebrata. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, pp. 380–381.
1857. Prodromus descriptionis animalium evertebrarum . . . Pars I. Turbellaria Dendrocoela. Proc. Acad. Nat. Sci. Philadelphia, vol. 9, pp. 19–31.

STUMMER-TRAUNFELS, RITTER VON
1933. Ergänzende Untersuchungen zum Literaturverzeichnisse. *In* Bronn, Die Klassen und Ordnungen des Tier-Reichs . . . . vol. 4, pp. 3485–3566, 138 figs., 1 col. pl.

YERI, MEGUMI, AND KABURAKI, TOKIO
1918. Description of some Japanese polyclad Turbellaria. Journ. Coll. Sci. Univ. Tokyo, vol. 39, art. 9, 54 pp., 48 figs., 2 col. pls.

Explanation of Numbered Parts on Figures

1, marginal eyes
2, cerebral eyes
3, frontal eyes
4, brain
5, pharynx
6, mouth
7, male gonopore
8, female gonopore
9, eggs
10, seminal vesicle
11, prostatic vessel
12, penis papilla
13, penis stylet
14, male antrum
15, ejaculatory duct
16, vagina
17, entrance uterus
18, duct of Lang's vesicle
19, Lang's vesicle
20, female antrum
21, glandular vagina
22, cement glands
23, sperm ducts
24, cerebrotentacular eyes
25, bulbous vagina
26, spermiducal vesicle
27, tentacle
28, uteri
29, spermiducal bulbs
30, common sperm duct
31, muscular vagina
32, thorns
33, teeth
34, bursa
35, black dots
36, tentacular eyes
37, cirrus sac
38, cement pouch
39, common gonopore
40, sucker
41, median ridge
42, tentacular folds
43, uterine network
44, papillae
45, eosinophilous droplets
46, nuclei
47, rhabdites
48, main intestine
49, accessory vesicles
50, penis sheath
51, cirrus papilla
52, gland pocket of male antrum

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